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UNDERGROUND WIRES.

In our last week's issue we made a few preliminary remarks upon underground wires, as this is a subject likely to play the most important part of all in the future transmission of electrical energy, whether it be employed for telegraphy, telephony, or the still more recent uses to which electricity has been adapted.

We spoke of the unsightliness of overhead wires, and the danger attached to their employment, which danger must become more and more apparent as aerial lines are increased in number. We may therefore, taking into consideration the present agitation going on regarding these overhead encumbrances to great cities, conclude, that in the very near future additional lines for electrical purposes will be placed underground, at any rate where passing through towns.

Last week we spoke generally of the difficulties to be overcome before a really satisfactory system of underground conductors is likely to be arrived at, for although many projects have been proposed we notice that the great majority of the inventors of these systems have not studied more than one point out of many which must be considered before a fair solution of the problem is set forth. Nearly all the recent devisers of underground methods have brought their ideas to bear upon the casing or tubes in which the conductors are to be placed. This in itself is certainly a very important item in the subject under discussion and well worthy of deep consideration, but would it not be more to the point to study first of all the properties of the conductors themselves before proposing methods for protecting them?

For instance, when we read of plans for underground systems of *naked* wires—arranged certainly so as to be insulated from each other when laid but placed in a so-called protecting pipe or gutter from which water cannot be excluded—one begins to think that the question of the insulation necessary for these wires might be studied with advantage in the first place. When a wire is placed underground its insulation must be continuous, and this has hitherto been effected chiefly by covering the conductor with gutta-percha or india-rubber, and these substances, for economical reasons, are put on as thinly as can be done with safety. Bare wires insulated at a series of detached points insulate fairly well in the open air where free exposure renders evaporation of moisture possible, but if these wires are boxed in, moisture will not be kept out. It is almost useless to think of making a successful and permanent system of underground conductors unless the latter be coated with an insulating material throughout their entire length, this material being either a solid, as is generally the case, or a liquid as in the case of Brooks' method of employing cotton-covered wires drawn through tubes, which are afterwards filled with paraffine oil. We have on several occasions pointed out that the insulating value of gutta-percha, although considerably lower than that of india-rubber, is yet much higher than is necessary. Our readers are also well aware that the *inductive capacity* of any insulating material plays a most important part in the facility with which we can communicate through a given length of underground wire, and also that if we increase the thickness of the insulating envelope and thus make a greater distance between the wire and the outside surface of the insulator, we gain in working facilities. But as we have already said, from economical reasons we can only allow ourselves to use a spare coating of an expensive material. But if we had a cheap substance of a sufficiently good insulating nature, and with no greater *inductive capacity* than our more expensive material, we can then for the same outlay cover our conductor to a larger size of insulator and thereby gain an increase of working capacity. The dimensions of a core may, however, in some cases be a matter for consideration, and the larger we make our conductors the less easy they are to manipulate and the fewer are the wires that can be placed in a given space. Above all things the durability of the material must not be lost sight of when selecting an insulator. Gutta-percha, for instance, we know to be almost everlasting under water, and its insulating properties are not dangerously affected at moderate temperatures, say under 90 or 100 degrees Fahrenheit. India-rubber has also special qualifications for the purposes of insulation, and has the advantage of a lower inductive capacity than its more favoured rival. Up to the present these two substances have had it all their own way owing to the comparatively small amount of underground compared with overhead wires. That this will not be altogether the case in future years we feel convinced, for although as much or more may be used as at the present day, other methods of insulating wires for underground work will be found actually necessary. Such matters might now with advantage be taken up by our wire covering firms. Inductive retardation is an obstacle which seriously impedes facility of communication, and will cause great trouble to telephony, more so than to telegraphy, for in the former case we are confined within certain limits, which in the latter case, although existing, can be more readily overcome.

Our readers have invariably responded freely to our invitations that they should express their opinions on matters of great moment to the electrical world, and we cannot conceive a more fitting subject for a thorough discussion both from a technical and a commercial point of view than is offered in the great question of underground *versus* overhead wires.

THE LIMITS TO THE TRANSMISSION OF FORCE TO A DISTANCE BY MEANS OF OVERHEAD TELEGRAPH LINES.

The question that we are now about to consider, says M. Hospitalier in *l'Electricien*, seems to have been systematically ignored in the various discussions on the subject of transmission of force to a distance by electricity, notwithstanding its importance from the point of view of industrial applications, and of the advantage to be gained by the utilisation of natural forces transmitted by electricity to a distance from the place where they are produced.

The problem presents special interest, and is comparatively easy to solve when we take the particular case of overhead telegraph lines; it can, in this case, be expressed as follows: *What is the maximum quantity of work that can be transmitted to a given distance on an overhead telegraph line*

of a given type? The answer of pure theory is that this quantity is indefinite, not to say infinite. Let E be the electromotive force (in volts) of the generator, and I the intensity (in ampères) of the current produced by it. The quantity of work transformed into electrical energy, W, can be expressed thus :—

$$W = \frac{E\,I}{g} \text{ kilogrammetres per second} \qquad (1)$$

or

$$W = \frac{E\,I}{75\,g} \text{ horse-power.}$$

If we choose E and I carefully, increasing the electromotive force and the intensity of the current in proportion to the distance, we can cause the generator to produce any quantity of electrical energy whatever, and we can obtain at a distance as great a quantity of work as we wish, whatever the actual rendering of the transmission may be. This is unfortunately not the case in practice, especially with overhead lines, where E and I can only vary between very narrow limits, which we will now consider.

Limits of E.—The electromotive force of the generator is limited by the exigencies of insulation, as much on account of the injurious influence of derivations, an influence which we will discuss presently, as of the actual danger incurred with high potentials. In the Northern Railway experiments the electromotive force never exceeded 2,500 volts, and yet an accident occurred, which, fortunately, was not attended with any serious results, but which should lead us to reflect before setting up overhead conductors with such high potentials. We therefore allow a wide margin when we limit the electromotive force of the generator to 3,000 volts, as we evidently run a risk as soon as we exceed 2,000 volts.

Limits of I.—The intensity of the current is only limited by the nature of the line and by its length. For the transmission to be economical the quantity of electrical energy expended in the conductor in the form of heat must not exceed a given fraction, k, of the total work transformed into electrical energy by the generator. Let R be the resistance of the line in ohms, the loss from the heating of the line will be, according to Joule's law :—

$\frac{R\,I^2}{g}$ kilogrammetres per second. The condition mentioned above will, therefore, be stated as follows :—

$$\frac{R\,I^2}{g} = k\,W = \frac{k\,E\,I}{g};$$

which gives, when worked out :—

$$I = k\,\frac{E}{R}. \qquad (2)$$

When R is determined, I can also be obtained, since E = 3,000 volts, and R represents the resistance of the line in ohms.

Determination of W^1.—We will suppose, in order to fix the maximum limit of the transmission, that it is effected under the most favourable conditions, *i.e.*, that the derivations are *nil* (we will explain presently why we lay special stress on this point), and that we have a final mechanical rendering of 50 per cent. In order to realise these conditions, we must not expend in heating the conductor more than 20 per cent. of the work transformed into electrical energy by the generator, which corresponds to 40 per cent. of the total effective work obtained at the receiver, W^1. For a rendering of 50 per cent. we get. :—

$$W^1 = \frac{W}{2} = \frac{E\,I}{2\,g},$$

and by substituting for I its value calculated from formula (2) we have :—

$$W^1 = \frac{k\,E^2}{2\,g\,R} \text{ kilogrammetres per second.}$$

or

$$W^1 = \frac{k\,E^2}{75 \times 2\,g\,R} \text{ horse-power.} \qquad (3)$$

The diagram (fig. 1) shows the results obtained from this formula, when

$$E = 3{,}000 \text{ volts.}$$
$$k = 0{\cdot}20.$$

R represents the resistance of the line in ohms (abscissæ).

W^1 represents the quantities of work within corresponding limits (ordinates).

We see that the maximum quantity of work that can be transmitted varies in inverse proportion to the resistance of the line, and that, for example, with a line of 900 ohms resistance (as in the Miesbach-Munich experiments) it would be impossible to obtain more than 1½ horse-power. The diagram (fig. 2) relates to overhead lines of a given type, the resistances of which are respectively 5 ohms, 10 ohms, and 20 ohms per kilometre. Curve 20 represents a double line formed of iron wire 4 millimetres in diameter ; curve 10, an iron wire of 6 millimetres, and curve 5, a copper wire of 3 millimetres. When we use high potentials the employment of a return wire is necessary, in order to reduce the chances of accident, which, with a return to earth, would render the electrical transmission of force to a distance inapplicable. The resistance per kilometre of each kind of line is, therefore, doubled by the employment of the double wire. It is only necessary to glance at the curves in order to see the limit to the quantity of work that a given line enables us to transmit to a given distance. Thus, for example, a double overhead telegraph wire 6 millimetres in diameter will not allow of our transmitting more than 6 horse-power to a distance of 20 kilometres ; at 60 kilometres this quantity would be reduced to 2 horse-power.

We must now proceed to justify the reservations we made in supposing the derivations of the line to be *nil*. This hypothesis caused no difficulty in determining the maximum limits of work transportable to a given distance with a given initial electromotive force ; but we must observe that it is

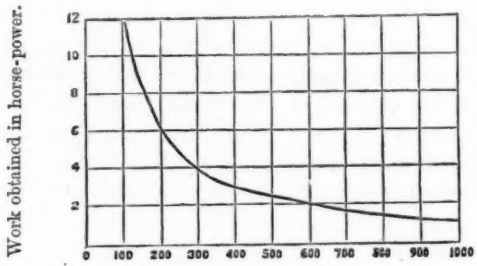


FIG. 1.—Maximum work obtained with the resistance of the line for E = 3,000 volts.

not justifiable in practice, and that the influence of these derivations will tend still more to diminish the quantity of work deduced from the formulæ that we have just laid down : What is the actual importance of the derivations in overhead telegraph lines subjected to high potentials ?

It has been concluded too hastily that these derivations do not exist, or that they are so slight that they can be disregarded in practice.

In reality, no direct experiment as yet authorises this conclusion. The report of the Committee at the Munich Exhibition is absolutely silent on this point, and in the Miesbach-Munich experiments we can find no reference to two simultaneous observations of the respective intensities of the current at departure and on arrival during the transmission itself.

Nor do the three series of experiments made at the Northern Railway give us any information on this subject, notwithstanding the conclusions of the report presented to the Academy by M. Cornu.

In fact, the measured resistance of the line employed was 160 ohms ; the resistance calculated from the ratio of the difference of potential at the extremities to the intensity of the current gave results varying from 138 to 179 ohms, say, a total difference in the measurements of 25 per cent. of the quantity to be measured.

But as the *average* of the five experiments made gives 159·6 ohms (very nearly 160 ohms), the writer draws the following conclusion :—

" This identity between the effective resistance of the line and the measured resistance is very important, from the point of view of agreement between theory and experiment, for the analysis of the phenomena of transformation of

energy in the circuit. It shows that the consumption of energy necessary to overcome the resistance of 160 ohms is practically exactly equal to the value advanced in theory.

"The discrepancy between the partial results arises from the inevitable variations in the speed of the machines, and especially from the impossibility of making absolutely simultaneous measurements."

It is impossible for us to accept this conclusion on account of the too great discrepancy between the partial results, more especially as, in the two first series of experiments the same calculation had given a diminution of

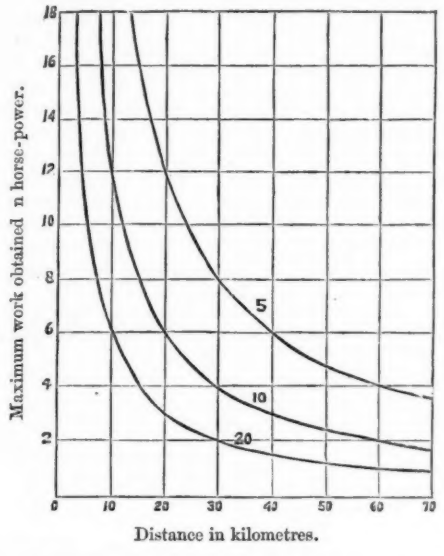


FIG. 2.—Maximum work obtained at a given distance upon a given line for E = 3,000 volts.

resistance in the line varying between 7 and 12 per cent. of its value measured directly. The discrepancy between the partial results indicates that the experiment should be repeated from beginning to end, but it by no means justifies the conclusion that the line presented all through the transmission the same electrical resistance.

But, besides this, even if these derivations were practically *nil* in the experiments of the Northern Railway, with loop

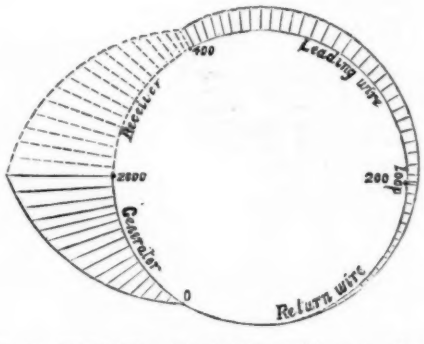


FIG. 3.—Distribution of potentials with loop coupling.

coupling, it does not necessarily follow that it will be the same case with actual distances. We need only refer to figs. 3 and 4 in order to convince ourselves of this. In these diagrams we have shown the distribution of the potentials over the different parts of the circuit, supposing this circuit to be in the form of a complete circle, and to have at each point at the prolongation of the radius a length proportional to the potential at that point, taking as the zero potential that of the negative pole of the generator.

We see thus that, with a difference of potential of 2,000 volts at the terminals of the generator, in the loop coupling (fig. 3), with the machines in juxtaposition, the difference of potential between any two points whatever of the line never exceeds 400 volts, whereas in the coupling at an actual distance (fig. 4) this difference varies from 1,600 to 2,000 volts.

The great difference in the distribution of the potentials over the line in the two cases clearly shows that these derivations will not act in the same way in both cases, and that they will be far from having the same absolute value. Unfortunately no direct experiment has been made on the derivations of overhead telegraph lines with a high potential, and we can only for the present refer to telegraphic experiments. There are certain experiments made on overhead telegraph lines, with continuous currents, which show that these derivations are far from insignificant. Therefore we were not a little surprised to read in M. Cornu's report to the Academy of Sciences the following passage :—

"We know, indeed, that the trial of telegraph instruments, under the conditions of connection in which the two machines are placed, would not allow of any conclusion as to the value of the instruments from the point of view of their rendering on the line, *i.e.*, their rapidity of working ; but this objection is singularly lessened when we reflect that the telegraphic signals are characterised by the discontinuity of the currents, a property which the electrical capacity of long lines, the electrification of the insulators, &c., tend to efface and destroy; this is why we cannot substitute for telegraph lines, when the valuation of an apparatus is in question, a short wire of equal resistance. But when a uniform current is transmitted these difficulties no longer exist, for we only want to know whether the electric current traverses without complications the given circuit, of which we have numerical proof in each experiment ; the objection drawn from comparison with telegraph instruments loses therefore the greater part, if not the whole, of its value."

From the time of the experiments made by M. Breguet, *by means of two well-compared sine galvanometers* (see

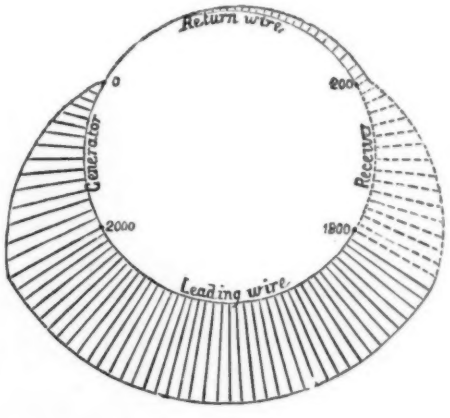


FIG. 4.—Distribution of potentials for a *true* distance coupling.

Gavarret's "Practical Telegraphy," 1861, p. 255), to the recent experiments of the lamented Schwendler in India in 1880, experiments in which the currents measured at departure and on arrival are expressed in milli-ampères, we know that derivations are produced on telegraphic lines traversed by continuous currents; we know also that with long lines it is true, but charged with potentials never exceeding 200 volts, the current received varies between 80 per cent. and 20 per cent. of the current transmitted. The discontinuity of the current, the capacity of the line, the electrification of the insulators, have absolutely nothing to do with this case, where a continuous current is used. The objection taken from comparison with telegraph lines, therefore, loses nothing of its value, and the answer given by M. Cornu is simply beside the question. The difficulties do exist and will soon show themselves when a real transmission of force is attempted by means of an overhead telegraph line, with high potentials, at an actual distance, and when it is decided that *all* the elements of the problem shall be measured, particularly the current transmitted in ampères and the current received in ampères.

The experiments of the Northern Railway have thrown no light on this important point of the question of transmission of force to a distance ; the part of the report that we have just quoted is in direct contradiction to the facts acquired in the numerous experiments made on overhead telegraph lines, with continuous currents.

These reservations justify the object of this article and its utility. We have, in fact, limited theoretically, under the most favourable conditions, the maximum quantity of work that is possible to transmit to a given distance, with a given initial electromotive force on an overhead line of given resistance ; the derivations will again reduce this quantity of transportable work to a certain degree, numerically unknown up to the present, but by no means to be disregarded. The few figures that we have given answer the illusions of those who would like to transmit to Paris all the work of the Falls of Niagara through an electric bell-wire. Exaggeration in anything is a fault, and we shall oppose it here every time it takes the electrical form in order to impose on the public credulity, in a speculative or any other interest.

To transmit much work to a great distance, thick wires are necessary ; in each particular case there exists, for a given force, a distance which we may call the critical distance, beyond which it is more simple and economical to have recourse to a direct production of the work on the spot, with a good ordinary steam-engine, or even—let those who are electricians *à outrance* close their ears—with a gas motor.

GÉRARD'S ALTERNATING-CURRENT MACHINE.

WE are under the impression that we have not yet placed before our readers an illustration of Gérard's machine. A convenient opportunity now offers itself, and we reproduce a short description of the apparatus from the *Revue Industrielle :*

"The machine represented in the engraving consists of a movable inductor, of which the alternate poles pass before the field-magnets, formed of a double row of flat oblong bobbins, which are fixed upon a ring connected firmly to the frame. There is a similar ring on each side of the inductor.

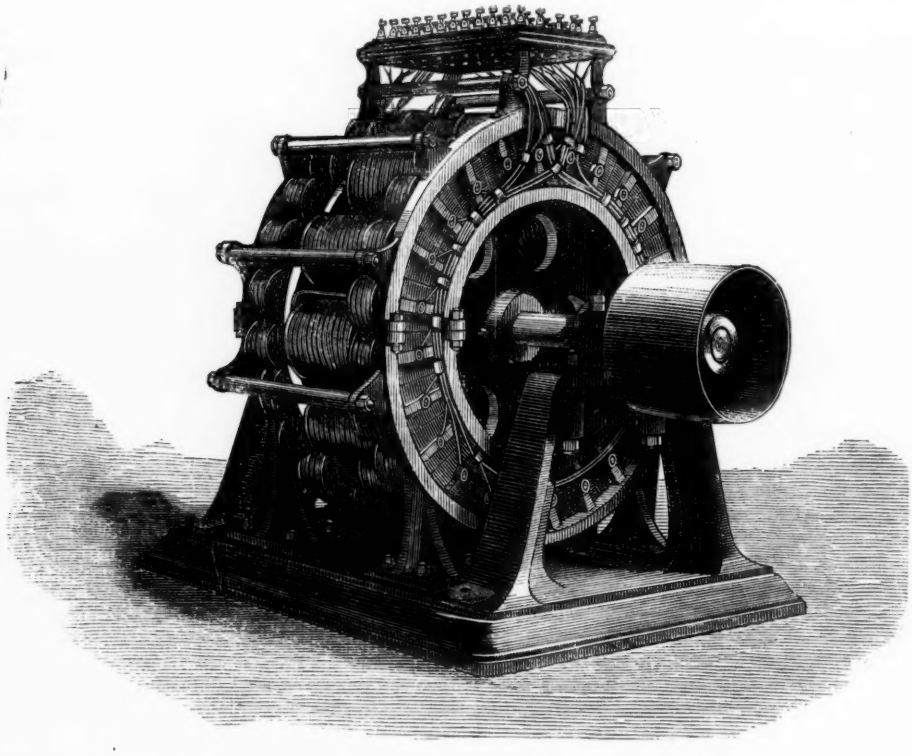
"The field-magnets are fixed, the wires from the bobbins are connected with terminals placed upon a board surmounting the machine.

"This arrangement allows all possible coupling of the circuits according to requirement—thus, one may divide the field-magnets into two circuits, allowing the burning of carbons 30 millimetres in diameter ; or one may have four, eight, twelve, twenty-four, or even forty-eight distinct circuits capable of being utilised entirely or partially.

"This machine has been devised with a view to render the lights independent ; one may, for example, produce a voltaic arc with an intensity from 250 to 600 carcels for the illumination of a court-yard, several smaller lights for workshops, or supply incandescence lamps.

"Each of the circuits being independent, one may easily light or extinguish one of them without inconvenience."

We believe that M. Gérard has devised a machine on a scale similar to that of Mr. Gordon's. His idea is to connect a Corliss engine of 250 H.P. direct on to an alternating-current machine, and the appearance of the apparatus is that of a single-cylinder horizontal engine with an immense flywheel. According to the inventor's statement this machine can maintain 1,000 lamps of a special type called "à glissière" (specimens of these arc lamps were shown in action at the Crystal Palace Electrical Exhibition of 1881-82, if we mistake not), and a larger number of incandescence lamps. We do not know whether this huge machine has been actually constructed and experimented with, or whether it has merely advanced as far as the designing stage.



Ourselves.—Contemporaries will oblige, in quoting from our pages, by prefacing the name of the Review with the word "London," thus : "London Electrical Review."

MILITARY TELEGRAPHS DURING THE AMERICAN CIVIL WAR.

(*Continued from page* 10.)

THE salaries of the telegraphists were very small in the beginning but were afterwards increased, so that towards the end of the war operators received from 75 to 100 dollars per month according to their capabilities and position, and horses, servants, and rations, according to circumstances.

The Military Telegraph Corps was developed simultaneously with the Military Signal Corps, which was in existence at the outbreak of the war. The latter had a military organisation and was under the command of Major, afterwards General, Myer. The work of this corps was at first confined to optical signalling, but Major Myer soon organised electrical field telegraph trains, each train being comprised of two waggons with office and line materials. The office apparatus was Beardsley's electro-magnetic needle apparatus, which was afterwards modified into a sounder. Each waggon carried eight kilomètres of field cable covered with vulcanised india-rubber, 200 poles and wire for overhead lines. As early as July, 1863, the signal corps possessed 30 fully equipped trains, with an exclusively military organisation. Major Myer now directed his efforts towards incorporating the Military Telegraph Corps (civil corps) which, under the direction of its chief, Anson Stager, had already made great strides, with the Signal Corps (military) under his own command. This not only gave rise to serious differences between the two corps, but also led to an event of great importance to the American military telegraphs. Myer wanted to absorb the Civil Corps; Stager wished the Signal Corps to be disbanded, and the Minister of War was compelled to decide between the two. His decision was to *disband the Signal Corps*. The fact that the Minister of War had dissolved a branch of the army in favour of a civil organisation appears extraordinary, but it had become a necessity, for the following reasons. The workmen, telegraphists and officers of the Signal Corps were soldiers, and the greater number of them were not professional operators or men who had made telegraphy the study of their lives. The Military Telegraph Corps, on the other hand, from its chief down to the line-men, consisted of fully experienced men. Whilst the latter corps was capable of carrying its stations to the front, operating on battlefields, and even within the enemies, lines, the Signal Corps, on the contrary, did not always fulfil the demands made on it, and thus frequently gave dissatisfaction. The rapidity and trustworthiness with which the Military Telegraph Corps acted, could never be attained by the unprofessional Signal Corps. On November 10th, 1863, Major Myer, by command of the Minister of War, was relieved of his post, and his field telegraph trains and materials were handed over to Anson Stager, chief of the Military Telegraph Corps.

A great part of the officers and men of the Signal Corps were then transferred to the Military Telegraph Corps. At the time it was disbanded the Signal Corps numbered 198 officers and men.

The organisation of the Confederate military telegraph was similar to that of the Northerner's, but was faulty in practice. Many telegraph officials had received the rank of officers, performed adjutant's duties, and accompanied cavalry regiments as field operators and cipher readers. The corps was wanting in such central command as the North had, and the telegraph was more subjected to the commands of the military heads of divisions; the operators were excepted from military duties.

When General Grant was appointed commander-in-chief, March 2nd, 1864, under the immediate orders of the President of the Republic, it became the task of the military telegraph to make it possible for the commander-in-chief to direct harmoniously from a central point the operations of all army corps which extended over an immense stretch of country, and thus to attain the highest degree of offensive power of this large but scattered army. To the American military telegraph belongs the glory of having shown, 20 years ago, not only the possibility but the wisdom of conducting military operations by telegraph from a distant centre, and by the direction of only one leader. The headquarters of the four army corps, which were many thousand kilomètres distant, and even the outpost positions were in telegraphic connection with Grant's tent in Culpeper, and more than 250,000 soldiers of the Republic received thence their daily orders.

In 1864 the field telegraph had attained such a degree of efficiency, that even on forced marches the headquarters remained in daily telegraphic communication. Telegraph Major Eckert reported on June 15th, that the working parties could erect an average of 39 kilomètres daily and take down an equal length. Not only was telegraphic communication maintained between General Grant and all headquarters of corps during all engagements, but the field telegraph also accompanied every considerable reconnaissance, and commanders often conducted whole campaigns from the telegraph station, without getting into saddle; as for example, General Rosecrans directed the Arkansas and Missouri campaign in 1864 from telegraph stations in St. Louis and Jefferson.

When Jackson and Sheridan marched against Richmond, in March, 1865, with 123,000 men to enact the closing scene of the great drama, the field telegraph kept the headquarters in uninterrupted communication with the line of battle, extending over 48 kilomètres, and the telegraph was the sole means of communication between the commanders, the President of the Republic and the ministry. When, on April 2nd, Grant ordered an attack on the Confederates entrenched in Petersburg under General Lee, the telegraph station of the Federal General Humphrey was literally on the field of battle, 500 feet behind a battery engaged in the action. The telegraph remained at work during the fighting. The taking of Petersburg was the eve of the fall of Richmond, and the end of the four years' bloody war, in which the Federals alone lost 300,000 men, besides the 400,000 who were disabled.

To the military telegrapher of the United States belongs the fame of first having carried out telegraphic transmission of orders on a large scale. During the four years' war 24,150 kilomètres of military telegraph line were erected; many lines were put up and telegrams sent under fire. 25 members of the telegraph corps lost their lives; 71 were taken prisoners, many lost their health in consequence of hardships and fever, and died soon after the war.* The cost of the erection and working of the 24,150 kilomètres of field telegraph during the four years' war amounted to 2,655,500 dollars. 6,500,000 telegrams were sent, many of them in the form of long reports, so that each military telegram cost the State about 40 cents. No branch of the service had cost the Government less than the military telegraph.

After the close of the war the telegraph lines in the Southern States were also given to the Military Telegraph Corps to be repaired and worked by them. The military telegraph thus contributed finally to the establishment of peace and the reorganisation of the country. After this the corps was gradually disbanded; in 1865 it ceased to exist, and the lines were sold and given over to private companies.

So much for the subject of this book, which is written for a humane and just purpose. The great trouble and pains which Plum has taken for so worthy an object carried out by him at the cost of time and expense insures the

* These great patriotic services and all this devotion the Government rewarded in only a few and exceptional cases. Long after the close of the war, at the end of 1866, seven telegraph officers, who had already received military rank during the war, were promoted. Stager and Eckert became brigade-generals; Lynch, Gross, Van Duzen, Clowry, and Gilmore were made lieutenant-colonels. The remaining officers of this deserving corps went empty away, and did not even receive from the Government so much as an expression of thanks or recognition, excepting that ten telegraphists each received from the Minister of War one of the silver watches which had served to regulate the time at the principal military telegraph stations, as a token of recognition of their valuable services. Plum says:—"The Government erects headstones over the graves of soldiers, and pensions those dependent on them. Not so for the operator. Why?" He also writes, in speaking of the telegraphist:—"Whose growing boy cannot say, 'My father was in the army, too,' because the rolls that he was paid on were the quartermaster's instead of the adjutant-general's." Such ingratitude might tend to lessen men's faith in the Great Republic. Such conduct must at least work in a demoralising manner upon the patriotic spirit of the citizens, and it might tend in future similar cases to diminish the holy virtue of patriotic devotion.

author the respect of all.* The work has a great historical value on account of the number of authentic data brought forward, and in describing in full detail the working of the American field telegraph, a subject hitherto almost entirely unknown in European military circles, Plum has chiseled a model for all armies the classic form of which may be imitated in future wars, although according to circumstances changes of organisation will of course be necessary. Plum's work, therefore, is highly instructive to military telegraphists and staff-officers, and particularly to those who until now were opposed to the use of telegraphy at the front, and who, in experimenting on the subject, have not gone into it with the thoroughness that it demands.

THE ELECTRICAL TRANSMISSION OF POWER.

[The Generator used in the experiments at the Chemin de fer du Nord.]

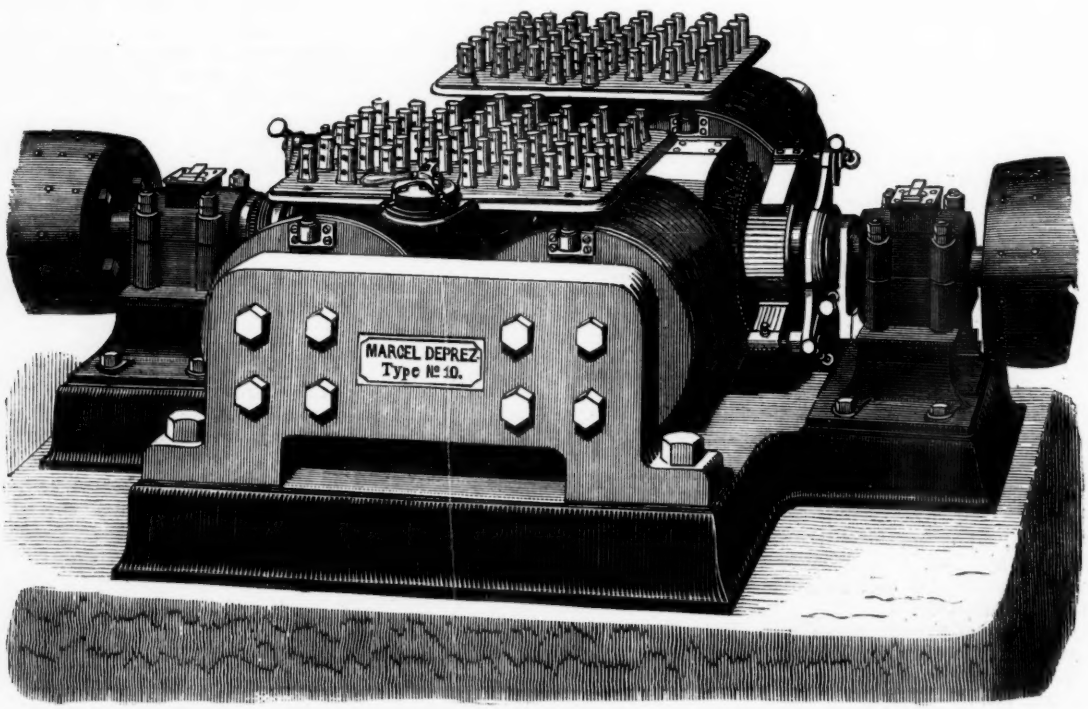
On the occasion of the experiments made at the workshops of the Chemin de fer du Nord, upon the electrical transmission of mechanical work, a very summary description was given of the machine which served to generate the current. "This machine was of a peculiar type, which I have devised," says M. Deprez in *La Lumière Electrique*, "after the experimental researches concerning dynamo-electrical machines which I commenced in November, 1881.

"The object which ought to be pursued in constructing a new type of dynamo-electric machine, is to make it absorb the greatest possible amount of work in relation to its weight, and producing the least possible heating at a given speed. This condition is much more easily proposed than realised. I believe, however, that I have nearly attained it in the experimental machine represented.

"It consists essentially of two electro-magnets with double coils, conformable to the principle which I patented in February, 1881, and with two branches with the contrary poles opposite each other, so as to constitute two magnetic fields, which naturally necessitates the employment of two rings from which the current may be received by a single collector. I preferred, however, to use two, each ring thus working absolutely independently.

"It may be said that my principal object in devising this type was to create a magnetic field of very great intensity, with a moderate weight of iron and copper, and to expend only a very small quantity of energy to produce it.

"In the experiments at the Chemin de fer du Nord the intensity of the current was 2·5 ampères, and the resistance of the inductors of the machine 20 ohms. The quantity of energy expended in the wire of the inductors reached scarcely $\frac{1}{6}$ H.P. This figure allows of judging whether I have attained my object.



"I shall return shortly to the results of experiments which I have made with this machine."

A very fair description of M. Deprez's machine was given in an article on the above subject, by M. Hospitalier, and which appeared in our columns at the time of the experiments. The illustration will, however, give our readers a better idea of the construction of these machines.

Commutator for different Combinations of Circuits.—A. Crova.—This apparatus consists of a wood cylinder with insertions, connected with the poles of six elements, and which come in contact with bars of ebonite inlaid with strips of copper.—*Wiedemann's Beiblätter.*

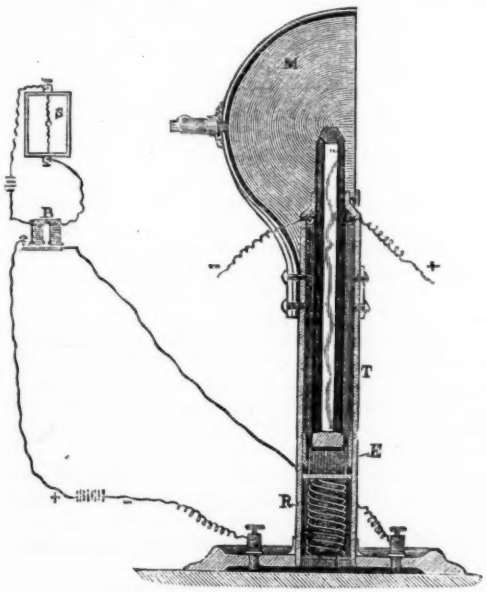
* Finally, let us mention that after the publication of Plum's work the efforts of the late American Telegraph Corps took at once a more definite form. Many of the widely-scattered fellow-workers of the telegraph were invited, on August 18th, 1882, to form a society, whose principal aim is to procure from the Government the recognition denied to them and the consideration which they deserve. This society has already held a meeting, on September 21st, at the Falls of Niagara, under the presidency of W. R. Plum. Many influential Americans took part in the meeting, and it was decided to lay their complaints before Congress. We wish the author and the gallant corps the best success in obtaining satisfaction t their just demands.

M. TOMMASI'S SELENIUM REGULATOR.

WE briefly alluded last week, in our "Notes" columns to the selenium regulator of M. Tommasi, which he has proposed to use in connection with Jablochkoff candles to keep the focus of the arc constant. We notice in our contemporary, *La Lumière Electrique*, an illustration of M. Tommasi's device, which we herewith reproduce with its description in detail.

The accompanying figure shows how M. Tommasi intends to install his apparatus. The Jablochkoff candle is placed in a tube, T, in which it tends to rise under the influence of a spring, R. It is, on the other hand, checked in ascending by an electro-magnet, E, whose core carries enlargements resting upon iron rails. So long as the current from a local battery traverses this electro-magnet it remains fixed against the rails, as well as the candle which it supports. When this current ceases the electro-magnet and the candle are raised by the spring.

The candle is surrounded by a reflector, M, bearing at the



height at which the light should be maintained an objective which concentrates the rays upon a selenium element, S. This is in the circuit of a second local battery, and of a relay, B, whose function is to keep the circuit, E, normally closed.

If the luminous point is lowered, the light no longer acting upon S, its resistance increases, and the relay then opens the circuit of E, so that the candle can rise until the luminous point has regained its position, and the original state of the apparatus is consequently restored.

The idea is an ingenious one, but as adapted to Jablochkoff candles seems to us somewhat out of place, as it destroys the extreme simplicity of M. Jablochkoff's invention. We think that M. Tommasi should rather turn his attention to the regulation of incandescence electric lamps by means of his apparatus, as apparently one regulator might determine the conditions of any number of these lamps. Perhaps, however, M. Tommasi has already directed his thoughts to this matter, which is certainly of more importance than anything connected with electric lighting by the arc system.

RAILWAY ELECTRICAL SIGNALLING APPARATUS.

ANY one who has searched through the specifications of electrical patents for the last twenty years must have noticed that electrical apparatus for signalling on railways has received a considerable share of attention, and even at the present day the subject continues now and then to be considered. Important as the whole question is, it does not, we think, present a large field for the electrical engineer to work in, more especially if the latter is not actually engaged in railway work. None but those who have had lengthened experience in the service of a railway company can realise what the actual requirements for railway signalling are, and hence it is rarely, if ever, the case that any system or improvement in a system, which has come into actual use, has been devised by an outsider. This, no doubt, is due to a great extent to the not unnatural unwillingness of the railway telegraph engineer to allow any inventions other than those emanating from himself and in which he has a pecuniary interest, to be brought into use; but, at the same time, it must be confessed that the very great majority of the inventions for railway signalling, except those actually brought out by the railway engineer, are practically worthless, and when examined, will show that the inventors know very little, if anything, of the subject with which they attempt to deal.

Electrical communication between passenger and guard has been frequently dealt with, but no really satisfactory solution of the problem has yet been obtained. This, we believe, is admitted by even the most prominent railway telegraph superintendents. Another favourite problem is to effect a means of communication between a railway train and one or other of the stations between which it is running; granting the possibility of effecting this satisfactorily, it is, we think, very doubtful if the game is worth the candle, at least in this country where the distance between any two stations is so short. The want of such a means of communication has never really been felt, and so long as the block system is properly worked, its utility must be very small, while the expense of carrying it out would be greater than any railway company would care about incurring.

THE DISCOVERY OF ELECTRO-MAGNETISM.

By DR. D. TOMMASI.

To whom belongs the honour of this beautiful and fruitful discovery, the applications of which, no less numerous than varied, cause it to be justly considered as one of the most brilliant and most useful conquests of the human mind.

Most physicists, not to say all, do not hesitate to regard Oersted as being the true and only author of the discovery of electro-magnetism, and yet this has not yet been established in a definite and indisputable manner. It seems, in fact, to result from researches undertaken in 1859 by Zantedeschi that the true creator of this new branch of electricity is an Italian, Romagnosi. But notwithstanding all his authority, Zantedeschi has not succeeded in causing his ideas to be adopted, and all the efforts which he made with the view of claiming for Italy the honour of the discovery of electro-magnetism have been absolutely fruitless.

The arguments by which Zantedeschi supported his view are not devoid of all foundation, as will be seen from the following article, published by an Italian journal in 1802, that is to say, 17 years before Oersted discovered the deflection of the magnetic needle by the current of the battery. In the *Ristretto dei Foglietti Universali* of Triente, of August 3rd, 1802 (quoted by F. Hoefer in his *Histoire de la Physique et de la Chimie*, p. 298), we read: "Councillor Giovanni Domenico Romagnosi, of Triente, hastens to communicate to the physicists of Europe an experiment relating to the galvanic fluid applied to magnetism. After having made a Volta's pile with discs of copper and zinc, between which were interposed circles of flannel saturated with dilute ammonia, the author attached to the pile itself a silver wire broken in different places like a chain. He then took an ordinary magnetic needle, disposed in the manner of a naval compass and let into a prismatic axis of wood. After having removed the glass cover, he placed the needle upon an insulator of glass, close to the battery. He then seized the chain, taking it by the glass tube, and applied its end to the magnetic needle. After a contact of some seconds, the needle deviated several degrees from its polar position. On removing the chain the needle preserved the direction thus impressed upon it; on applying the chain anew the needle again deviated a little and preserved the position in which it was left, so that its polarity seemed entirely destroyed. M. Romagnosi to restore it proceeded as follows: he pressed

with both hands, between the thumb and the fore-finger, the edge of the insulated box, but avoiding any shaking, and held it for some moments. The needle was then seen moving slowly and resuming its polarity, not all at once, but by successive pulsations, like the seconds hand of a watch. This experiment was made in the month of May, and was repeated in presence of several witnesses."

In conclusion he asks, "Is it to Oersted or to Romagnosi that we should ascribe the merit of having first observed the deviation of the magnetic needle by the action of the galvanic current?

"Had Oersted any knowledge of the experiment of Romagnosi when he published his discovery of electro-magnetism?

"Have any other *savants* taken part in this discovery?"

The author submits these questions in particular to the Managing Committee of the Vienna Exhibition, in the hope that they may be brought before electricians.—*Cosmos les Mondes.*

REVIEWS.

The Law of Electric Lighting. By HENRY CUNYNGHAME, Barrister-at-Law, late Royal Engineers. London: Stevens & Sons.

WE have here a treatise on the law of electric lighting, with the Acts of Parliament, Rules and Orders of the Board of Trade, a Model Provisional Order, and a set of forms; to which is added a description of the principal apparatus used in electric lighting, with illustrations. In the second portion of Mr. Cunynghame's work, which the author modestly describes as "Notes on Electricity," we find chapters on the elementary principles of magnetism and electricity illustrated by means of original and clever diagrams. In fact, with the exceptions of the drawings of dynamo-electric machines, which are reproduced from Mr. Dredge's admirable work on Electric Lighting, Mr. Cunynghame's sketches are entirely original. In the chapter dealing with dynamos, we find the most important and the latest machines concisely described and dealt with. Electric lamps, conductors, electro-motors, electric meters, accumulators, the cost of electric lighting and other matters are well considered.

We have already been privileged in producing in our columns an extract from Mr. Cunynghame's book (see ELECTRICAL REVIEW for June 16th), entitled "An Explanation of the Gramme Ring," and when we say that the rest of the author's work is fully as interesting as the extract referred to, we feel sure our readers will not fail to make themselves still more acquainted with Mr. Cunynghame's writings. In the preface the author says regarding his "Notes on Electricity," "Without pretending to compete with more elaborate works, I hope they may be found useful. They have not been compiled from books but are the result in every case of an examination of the actual apparatus." This fact alone should be sufficient to excite curiosity as to the results of the author's examinations, and when we mention that he has devoted some attention to the effects of currents upon the human body, the induction coils of Messrs. Gaulard and Gibbs, surgical incandescence lamps, and other subjects which are not usually more than touched upon in books of this kind, we need scarcely add that we expect our readers will be eager to make Mr. Cunynghame's acquaintance through the medium of his "Notes on Electricity," even if they would rather not meet him embodied in his "Legal" form.

We have no hesitation, but the greatest pleasure, in not merely recommending but strongly advising everybody legally, commercially, or practically connected with the subject of Mr. Cunynghame's treatise to add this book to their existing *répertoire*. For ourselves we may say that we have derived much pleasure and no little profit from the work on which we have made these few remarks.

Electric Light: Its Production and Use. Second Edition. By J. W. URQUHART, Electrician. London: Crosby Lockwood & Co.

THIS work would be called by some of our American cousins a "re-hash" of old writings. Such productions, although not palatable to all, have their uses, and Mr. Urquhart's book will be found of service to many. The author has not the facility for placing what he has to say before his readers in the way which forms such a conspicuous feature in the manual by Mr. Bromley Holmes, which we reviewed a few weeks since. In fact, his style is laboured, and not such as to lead a reader to peruse his pages without a certain feeling of weariness. Nevertheless, Mr. Urquhart has managed to produce a comprehensive account of nearly all which has taken place in the practice of electric lighting, and his numerous illustrations are good, better, in fact, than we generally look for in English books of this character. The volume has the advantage of being edited by Mr. F. C. Webb, and we can recommend the work as a simple and descriptive treatise on the subject, and one in which something useful to all engaged in electric lighting matters will be found.

A New Departure in Medical Electricity. By S. A. MORTIMER FOOTE. Morton & Burt, printers, 103, Star Street, Edgware Road, W.

THIS is a pamphlet of 40 pages, and is one of the most extraordinary productions we have come across. The author is very anxious to have his ideas brought to the notice of the electrical world, but we think he would have been wiser had he committed his manuscript to the waste-paper basket instead of printing it. Probably the writer has some mysterious hidden meaning in his statements, otherwise it is difficult to say what must have been his state of mind when he committed his thoughts to writing. On page 4 we come to the following:—"The electric lamp transforms, by a 'material apparatus' electricity into magnetism." One can judge of the author's accurate knowledge of electrical laws by the following. Speaking of current strength, he says:—"By *doubling* the strength, I ought clearly to *double* the production of light;" and again, in the page following: "If I *double* the strength of current, the quantity of heat produced will be *doubled*." It is hardly necessary when we meet with such remarks as these, which are repeated more than once, to examine into the whole contents of the 40 pages, but we may state that the author's object is to announce his *great discovery* that "electricity acting on flesh deprived of blood or fluid, is a deadly poison;" and we may also state that the general style of the production is that of a race of medical practitioners who are not recognised by the medical profession as belonging to themselves.

ON THE MEASUREMENT OF THE INTENSITY OF CURRENTS.*

IN order to measure the intensity of currents in absolute units we employ in laboratories either the tangent galvanometer or the electro-dynamometer in one form or another.

Practically it is generally preferred to use galvanometers specially constructed for this purpose, and graduated beforehand in ampères by the maker. These quantity galvanometers are, in fact, sufficiently accurate for the requirements of industry; they are very convenient, because they are portable, their indications are almost instantaneous, and their employment requires neither study nor calculation. It may happen, however, that one of these instruments is defective or the indications may require verification. It is necessary, then, to be able to measure the absolute value of the current, and in this case it may be useful to employ the following method, which also dispenses with the use of the tangent galvanometer of the laboratory.

The current to be measured is passed through a long, straight copper wire stretched vertically. A small compass-needle is arranged at a distance from the vertical wire equal to a; the axis of the wire and the centre of the needle are in the same magnetic meridian. Under the influence of the current of intensity, i, the needle deviates to the angle, α. If a has only a length of a few centimetres and the wire is more than a metre long above and below the horizontal plane which contains the magnetised needle, we may consider the vertical wire as infinitely long. In this case we have

$$i = \tfrac{1}{2}\, a\, \mathrm{H} \tan. \alpha \qquad (1)$$

* G. Lippmann in *La Lumière Electrique.*

In this formula H signifies the horizontal intensity of the terrestrial magnetism; we have H = 0·193 at Paris.

We may get rid of a so as to render the co-efficient of the tangent of a equal to unity. It is enough to take a equal to 103 millimetres, we have then simply

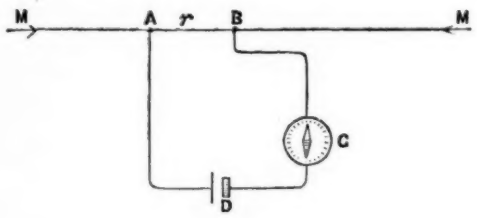
$$i = \tan.\ a. \qquad (2)$$

In formula (2) i is found expressed in absolute units, C.G.S. If we wish to have the value of i in ampères, it is necessary to multiply by 10, that is to say, to apply the following formula:

$$i = 10 \times \tan.\ a. \qquad (3)$$

Placing the needle at 1·03 centimetres from the wire, the formula (2) would give the intensity in ampères; but it would be necessary then to reduce proportionally the length of the needle, which would be rather difficult.

This mode of measuring i is very simple; but the method will be found defective if, in the neighbourhood of the operator, there are masses of iron or magnets which add their influence to that of the terrestrial magnetism. We



may then take them into account by measuring the relation of the local value of H to its normal value by the aid of the method of oscillation. But this is certainly very complicated. In this case we may replace the preceding method by that which we are about to point out.

The current to be measured is passed through a metallic wire, M M¹. Between two points, A and B, of this wire are placed in derivation a circuit which contains a galvanoscope, G, and a Daniell element, D. The electromotive force of the Daniell element is opposed to the difference of potential between the points A and B. If there is a suitable distance between these two points we reach equilibrium, the galvanoscope does not deviate. We have now

$$r\,i = 1{\cdot}12 \text{ volt}. \qquad (4)$$

The second quantity represents in volts the electromotive force of the Daniell element*; r is the resistance of the portion of wire, M M¹, included between the points A and B.

This method, therefore, only supposes that we know the resistance between A and B; it is independent of the value of the terrestrial magnetism, and it allows of making use of any galvanoscope whatever. Besides, it allows, in the case of a variable current, of finding the intensity at a given moment; the employment of a galvanometer in such a case implies the measurement of the duration of contact. Formula (4) gives

$$i = \frac{1{\cdot}12}{r}$$

r being expressed in ohms, this value of i is expressed in ampères.

NOTES.

Electric Lighting.—In the House of Commons on Thursday of last week, on the motion of Mr. Chamberlain, the Electric Lighting Provisional Orders Bill, the Electric Lighting Provisional Orders (No. 4) Bill, and the Electric Lighting Provisional Orders (No. 5) Bill were referred to a hybrid committee. Should their course be favourable they will become law before the session ends. The Electric Lighting Provisional Order (No. 11) Bill was issued on Monday for the purpose of confirming the Order made by the Board of Trade under the Electric Lighting Act, 1882, relating to Dundee. On Tuesday, in the House of Commons, on the order for the second reading of Electric Lighting Provisional Order Bills, Mr. Chamberlain, in answering Sir G. Campbell, said these Orders were entirely unopposed. To allow opposition of any kind from any person before the hybrid committee would entail great expense, and actually defeat the object of the Provisional Order system. The bills were read a second time, and referred to the committee on unopposed bills.

Messrs. Ganz & Co. have successfully installed the incandescent light in the National Theatre at Budapest. The same firm is now installing the "Pannonia," one of the largest steam mills in Budapest, with 400 incandescent lamps.

The Bermondsey Vestry met last week, when the clerk reported that he had received notice from the Brush Electric Light Company that they would apply for a Provisional Order in the ensuing session of Parliament, should any circumstances beyond their control prevent the passing of the Bill now before Parliament.

The Electric Sun Lamp and Power Company having completed its installation of the Sun light in seven of the picture galleries in the two Jones' Bequest rooms and in the reading-room of the South Kensington Museum, these were illuminated and open to public inspection on Tuesday night. In all, 40 lights of 1,200 candle-power each are in use, the current being supplied from four Gramme alternating-current dynamos, fed by two ordinary Gramme exciters, and driven by a 30 horse-power nominal steam-engine by Fowler & Son, Leeds, situated in a large wooden shed near the entrance to the museum. The Sun light, which is the invention of M. Clerc, is an improved form of the Lampe Soleil, which we described in our issue of the 17th June of last year. An important portion of the light is derived from the intense heating of the marble by the arc between the carbon points. Two short pieces of carbon, 20 millimètres in diameter, are inserted, one on either side of the block of marble. The ends of the holes into which they are fitted approach each other within a distance of 20 millimètres. Into this intermediate space a short conical hole is bored, across the apex of which the electric arc passes, heating the surrounding marble into a bright incandescent glow. On starting the light, contact is made between the two electrodes by a small carbon rod inserted through one carbon, which is hollow. As this small rod is drawn back, the arc follows it until the entire arc plays between the two large electrodes. To reduce the power of the light, which is remarkably steady, the lamps are inserted in lanterns covered with opal globes. In the reading-room the light is inverted, and thus reflects from the wall and the ceiling. In this way a very comfortable, agreeably soft, and shadowless light is obtained. Should this installation prove successful the Electric Sun Lamp and Power Company will, we understand, be entrusted with the lighting of a good deal of the remainder of the museum.

In order to further the progress of electric lighting, the German Government has ordered that Edison and Swan lamps shall be admitted on payment of a nominal import duty.

The Kirkcaldy Town Council met on Monday night—Provost Swan presiding. An intimation was read from the Brush Electric Light and Power Company (Limited) as to lighting with electric light certain districts of the town. After some discussion, in the course of which a remark was made that if the electric lighting of the town were a paying thing the Council should take it up, the matter was remitted to the Provost's committee.

A correspondent to a Glasgow paper writes: "I am surprised at the delay in recovering the bodies from the ill-fated steamer Daphne. If nothing more can be done to give readier access to the divers, it has occurred to me that their operations would be very materially facilitated if a dozen or two of Swan's electric lamps were let down into the hold. I remember Professor Preece showing these lamps burning brightly *under water* in the City Hall, and he remarked how useful they might be in diving operations. I notice that the want of light is a great drawback to the divers' success, and that they are resorting to illuminating paint, which must be a poor substitute for the electric light.

* The electromotive force of a Daniell element is 1·079 volts, not 1·12 volts, as stated by M. Lippmann.—EDS. ELEC. REV.

The Metropolitan Board is petitioning to be heard against all the Electric Lighting Provisional Order Bills having reference to the Metropolis. The House of Commons having decided, contrary to the advice of the President of the Board of Trade, that the hybrid Committee to which the Confirming Bills are referred should be empowered to hear parties against the Bills irrespective of their *locus standi*, the Metropolitan Board is thus enabled to come forward and oppose the Provisional Orders, notwithstanding these have been already settled as between the Vestries, the Electric Lighting Companies, and the Board of Trade. The Vestries and District Boards of the Metropolis are the local authorities specified in the Electric Lighting Act of last year, and the Metropolitan Board only comes in as connected with the raising of loans. The conduct of the Board in seeking to interfere with settlements already made before the Board of Trade between the companies and the vestries is felt by the latter as an invasion of their rights. The Metropolitan Board has a certain superintendence over the gas supply, but that is provided for by Act of Parliament, and there is nothing of the kind in respect to electricity. The avowed object of the Metropolitan Board is to prevent the creation of a monopoly like that of the gas interest. But the vestries assert, in effect, that the help of the Metropolitan Board is not necessary for this purpose. In a few cases where the vestries are themselves opposed to the Provisional Orders, they may either let the Metropolitan Board represent their case, or may undertake their cause themselves in their own right. On the whole, the progress of electric lighting in the Metropolis seems destined to receive a check in a quarter where it was least expected. It may be explained with respect to the Provisional Orders that although they bear the names of extensive parishes and districts, it is not always the fact that the area dealt with is that of the entire parish or district in question. Generally the proportion is a very small one.

Several gentlemen have written recently to the *Times* on the subject of electric lighting in London, amongst them being the well-known names of Mr. Charles Mossop, the Chairman of the Chelsea Electric Lighting Committee, and Sir Charles Bright, C.E. Mr. Mossop's last letter is worth reproducing, as it covers the ground taken by several correspondents. It runs as follows :—

"Since my last letter was written the Metropolitan Board has changed front. Instead of the offensive proposals suggested by their petition they have prepared clauses which, so far as Chelsea is concerned, are quite harmless.

"But the petition against the order remains, and the Board will not give up the clause as to revision of price every seven years. The company and the Board of Trade remain firm on this point, and we have, therefore, the prospect of the scandal of two public bodies fighting, and in the meantime we get no light.

"'H. L. C.' says we are going to give a monopoly of Chelsea to the Brush Company. This is a fallacy, and it is curious that one knowing so much on the subject as 'H. L. C.' should have fallen into such an error. The parish of Chelsea contains 800 acres. Schedule A covers 50 acres, schedule B 150 acres. Even as regards schedule A (the part to be compulsorily lighted within two years), we have reduced that area by forcing the company only to light those parts of Pont Street, Sloane Street, Cadogan Place, Harriett Street, Lowndes Street, and Lowndes Square to the north of Pont Street. Surely this is a sufficiently tentative process. Supposing the company does not light these parts within two years, they lose their order. If again, within two years and six months they do not light the rest of schedule A they lose their order. Within six months from the passing of the order the company has to set aside £20,000 as a separate capital for the undertaking (schedule A), and they must also deposit £2,000. If they fail they lose their order. When they commence schedule B they have again to go through the same process, and are subject to the same penalty

"I fail to see that any portion of this £20,000 or £2,000 will be paid for patent rights, as suggested by Sir Charles Bright.

"I fail also to see how the ratepayers are to be injured. If the Vestry were to erect works themselves then the ratepayers might be injured, but the ratepayers will not pay anything for lighting Chelsea to this company unless they supply the streets on terms that are satisfactory to us. Sir Charles is, I think, treating "ratepayers" and "householders" as synonymous terms. The householders are not obliged to take the light, and I presume they will not take it unless the company's terms are satisfactory.

"We cannot wait for the best or cheapest light, or we should wait for ever. Surely it cannot be suggested that science in this matter will stand still; and the argument that another company is now willing to light on cheaper terms is answered by the fact that the company could have asked for a provisional order or licence, and the vestry would have supported the best and cheapest, and the licence for choice; but this company did nothing of the kind, and we must take the only offer we have. Besides, is it for a moment to be supposed that this one company could supply all London ?

"All we ask of the Metropolitan Board and Parliament is to be let alone; and I cannot help thinking that if the Metropolitan Board would withdraw their petition now, Parliament would let those orders go through where the local authorities are content.

"If not, it is obvious that no order will go through this session, and the whole of our time and labour is thrown away.

"The objections should have been made to the Act of last session. They could, again, have been made at the beginning of this session when there was time to fight. The Metropolitan Board could have tried to get the order into better shape, as we did; but they did nothing. They have not helped the public. The clauses they now propose are only to protect themselves, and so far as my judgment goes, the Metropolitan Board are already amply protected by the order and the Act."

The Electric Lighting Act.—At a meeting of the Chelsea Vestry on Tuesday week, a report was brought up by Mr. Charles Mossop, the Chairman of the Electric Lighting Committee, from which it appeared that the Metropolitan Board of Works had presented a petition against the preamble of the provisional order for Chelsea granted by the Board of Trade to the Metropolitan Brush Company, which had been approved of by the vestry. He pointed out that the vestry was the local authority named in the Act, and that the main sewers and works vested in the Metropolitan Board were already amply protected by the order, and in other respects that the Board had no direct interest in the parish, and protested against the interference with the principles of local self-government at the eleventh hour, more especially as the Vestry had so fully mastered the subject and agreed with the Board of Trade. He further complained of the want of courtesy of the Board in presenting a petition without communicating with the Vestry, and apparently obstructing the operation of the Act in the Metropolis. The Vestry unanimously approved the report, and resolved to support the provisional order and to oppose the action of the Metropolitan Board of Works, and sealed a petition accordingly to the House of Commons. During the discussion it was much deplored that there should be a want of unanimity between the Vestry and the Board, and a possibility of the ratepayers being involved in a double and entirely unnecessary expense. Further information on this topic will be found in our Electric Lighting Notes.

French Electricians.—The monthly meeting of electricians held in Paris has developed into a new institution, which is to be called the Société des Electriciens. A committee has been established for determining the regulations to be proposed at a general meeting next October. M. Cochéry, Ministre des Postes et Télégraphes, has been appointed honorary president of the society.

The Vienna International Electrical Exhibition.—Lord Sudeley, Sir William Thomson, Sir William Siemens, and Sir F. Abel, C.B., have been appointed British Commissioners for this exhibition.

The Patents' Bill.—In the House of Commons on Monday, Sir Lyon Playfair brought up the Patents' Bill from the grand committee, and its consideration on report was fixed for that day week.

A New Electric Launch.—A new electric launch is being fitted up at Millwall by the Electrical Power Storage Company. The craft is of iron, and measures forty-six feet in length. Her motor is a Siemens dynamo of the D^2 type, and works direct on the screw shaft without any gearing. The screw is of unusually narrow pitch, in order to enable the dynamo to run with a high velocity. She carries sixty-five accumulators of the Faure-Sellon-Volckmar pattern of the same size as those used in the smaller electric boat constructed last autumn by the same company, and which was fully described by us. In the private trials made a speed of eight miles per hour was maintained. The boat, we understand, will be sent to Vienna.

Sixpenny Telegrams.—In the House of Commons on Thursday of last week, Mr. Fawcett, in reply to Mr. Lewis, stated that the Government would not come to any decision as to the particular scheme for introducing sixpenny telegrams before next session, and that there would be no objection to give, as far as practicable, details of the financial results to be anticipated from each of the three schemes mentioned in the Treasury minute. On Monday, in answer to Mr. Alderman Lawrence, Mr. Fawcett said it was, no doubt, the case that under Schemes 1 and 2 it would be possible, under certain circumstances, that a higher charge would be made for telegrams of twenty words than at present; but he could not agree with his hon. friend that there would be few telegrams for sixpence. On the contrary, he thought that under either of these schemes a great number would be sent. If any change whatever was adopted, with regard either to free addresses, or what would render it possible to charge more than 1s. for twenty words, it would be necessary to introduce a Bill. Mr. Alderman Lawrence gave notice that on an early day he would move "That any scheme for reducing the minimum charge for Post-office telegrams to sixpence, should recognise the fact that much longer addresses are required by artisans and small traders than by merchants and bankers."

The Railway and Electric Appliances Company.—The hearing of the petition for the winding-up of this company, which was presented by the Duke of Manchester and the majority of the directors of the board of the company, the particulars of which were reported in our issue of the 30th ult., was concluded before Vice-Chancellor Bacon in the High Court of Justice last Saturday. Mr. Millar, Q.C., and Mr. Carson were for the petition, which was supported by Mr. W. S. Owen, for the company, and was opposed by Mr. Marten, Q.C., and Mr. Northmore Lawrence for Mr. Smith, a director of the Williams Company; Mr. Hemming, Q.C., and Mr. Buckley for the National Company; and Mr. Maidlow, Mr. Sturges, and Israel Davis for fully paid shareholders. Vice-Chancellor Bacon, in giving his judgment, said that the petition was utterly wild and unreasonable. There had arisen a quarrel between some of the directors, and they desired to have the company wound-up at the will of some of the body, on the ground that it was just and equitable to do so. It did not seem just and equitable against the will of a large number of the shareholders, to disappoint their hopes and take away their property. If Mr. Smith had taken bribes and acted fraudulently, that must be decided in other proceedings. The whole secret of the proceedings seemed to be that those who supported the petition desired to form a new company on the ruins of the old. There being no evidence in support of the charges made the petition must be dismissed with costs.

Underground Wires.—It is reported that Mr. Edison thinks the compulsory placing of all electric wires underground would be very hard on the telephone people, but not much of a hardship to the telegraph people. In all large cities electric wires ought to go underground. With telephone wires it is different, owing to the induction, which makes it difficult to talk over wires so laid. There has been no means, thus far, found out, says Mr. Edison, to stop the induction on telephone wires, except by using a metallic circuit, which requires such a large outlay that it would practically wipe out the telephone business. The telegraph companies ought to be compelled in cities to put their wires underground.

The Underground Wire Question.—Mr. W. A. Stern, an electrical engineer of Philadelphia, has addressed a communication, dated June 25th, to the Select and Common Councils of that city relative to the question of placing all electrical conductors underground. We look upon Mr. Stern's letter as not a little curious, for he makes almost identically the same remarks concerning the systems brought forward for underground wires in America which we have done in our other columns, respecting the majority of the proposals put forth here, and therefore we think that the publication of Mr. Stern's comments will add force to those we had already penned. The American electrician's communication —with which we do not agree in every particular however— is as follows:—

"In consequence of the near termination of your long controversy on the question of putting telegraph, telephone, and electric light wires underground, and my fear that you may have been misled or prejudiced by the great number of side-show exhibitions of the different systems presented before you, in addition to the charlatanry resorted to in the articles on the subject appearing in daily print, I deem it my duty to say something on the question.

"Nor do I blame you for having formed such favourable opinions. On the contrary, I do not see how any one, save an electrical expert, could come to any other conclusion, after reading the numerous articles, or rather the one-sided controversy, than that the running of underground telegraph, telephone, and electric light wires is not only thoroughly practicable, but that it has been done and with great advantage and economy over the present system of aerial lines. In fact, that it is through its experimental age, and is now a grand success.

"It is my intention in this communication, in addition to showing you that there is absolutely no system, claiming to place telephone, telegraph, and electric light wires together underground possessing sufficient merit to be used practically and commercially, that it will be detrimental to the interests of the people, to grant permits to these various companies, as it will be a means of tearing up the streets and inconveniencing the public, and will have only the effect of enabling the representatives of these various systems to better manipulate their stock, for they will never be used as a system of underground telegraph.

"Although exhibitions of these systems have been given and demonstrated satisfactorily to people, as they thought (by the short time exposed) that telephone, telegraph, and electric light wires could be successfully placed in juxtaposition to one another, it has been no data or satisfaction at all to the electrical engineers, for the reason that the factor of time enters strongly in pronouncing tests of this nature satisfactory, as I show below. And why should electrical experts not be asked to examine and look into so important a question as this? Certainly, electricity should now be recognised as a separate and distinct department of engineering, and since in anything mechanical or scientific the city has always had its engineers appointed to investigate the same, I do not see why it has not done so in this. To this some one might reply that there were electrical experts at all these tests and they were said to have considered them highly satisfactory. If such is the case it reflects very poorly upon the scientific ability of these engineers. Who were these experts? They are not known generally to the electrical world, and from none of them have we received a report based upon the scientific condition involved. At none of these tests have such experts as Professor Geo. F. Barker, of the Pennsylvania University, or Professor Henry S. Morton, of Stevens Institute, or men of their kind, been asked to examine the merits of these systems. Before any concession of street privileges be given these various companies, councils should appoint a committee, composed of scientific electrical men as well as practical engineers, whose duty it shall be to report fully upon the scientific conditions of any system, and also on the overcoming of all mechanical obstacles in the way of running them, for the reason of allowing space to only those that have merit; for we are rapidly advancing in the application of scientific principles to the industries. And many years will not elapse before all agents such as heat, steam, cold air, electricity, will be served to the individual's quarters from a central generating point as gas and

water are to-day. And in anticipation of this view it is safe to remark that the street area available for the introduction of all these various inventions is so small as to require the greatest amount of judgment in placing the different pipes and conduits, &c., to insure our getting the benefit of all improvements in the sciences by having enough room in our cities to allow their introduction.

"But in all systems that have been presented to you, which claim to run successfuly telegraph, telephone, and electric light wires together, there has been absolutely nothing done towards the improving of electrical imperfections. In fact, the great number of patent specifications on this question seem to differ simply in quality and nature of material used for conduits, and manner of making same, while no attention has been paid to the better insulating of the conductors, the most important part of all, since they are to be placed alongside the high tension and dangerous currents of the electric light wires. If we have once found a means of covering a wire so as to last a number of years, and offer such a resistance to the passage of the current from the wire, or, in other words, make the leak from the high-pressure electric light currents to the telephone circuits trifling, we could simply then throw them in the ground any place without the need of those beautifully shaped holes of the present underground system. In short, that is the whole invention, a piece of concrete, or other nonconducting material, with a number of prettily shaped holes.

"To place electric light wires with those of the telegraph and telephone would not only be commercially unsuccessful, but would be very dangerous. There is no such thing as an absolute non-conductor of electricity, but in comparing with good conductors, some materials are for practical purposes considered insulators. Now, if we were to have electric light wires come in contact with those of the telegraph and telephone, a slight amount of electricity will leak from one to the other. And since electricity in its passage along a conductor is converted into heat wherever it meets resistance, it would have this effect just at the point of the crossing. And in consequence of the insulating materials consisting mainly of carbonisable materials, there would be a tendency due to the heat to produce a slow conversion into carbon. When this is complete it is a fair conductor, and allows the heavy current to pass to the telephone line in large quantity, where it again encounters more resistance at the instrument, is again converted into heat and will in all likelihood set fire to office, house, or wherever the telephone happens to be placed. It would certainly have the effect of increasing the rates of insurance on any building in which such a wire terminated, and our merchants now feel as though they were paying sufficient for the use of this indispensable service.

"Aside from all the objections mentioned, not one of these systems means an absolute doing away with all overhead wires. It simply disposes of the least objectionable ones while making no provision for the house top or dangerous wires. You all know what obstruction these offer to the firemen. In addition to this anything strictly underground would mean the tearing up of one's pavement and street every time a telegraphic or telephonic apparatus is to be inserted into a house. And I consequently hope that we will not be obliged to suffer this inconvenience until we have a system that is complete. I strongly favour underground electric wiring, but not until we have a good system, and I conscientiously say that that time has not yet arrived."

Electrical Railways.—In regard to electric railways Mr. Edison recently said to the representative of the Chicago *Tribune*: "They are somewhat new just now. They have been worked up to a point where they are capable of being used in a great many places, such as in streets, on the ground and elevated roads, for short distances, say from three to four miles in length. It will take some time before they can be used on the long and large roads. I am building a locomotive at my Goerck Street works in New York. It will have 375 indicated horse-power and six-foot drivers. It will be used on the underground railway in London, where smoke and vapours are very offensive. It will haul from eight to ten passenger coaches at a high rate of speed—40 or 50 miles an hour. We put in a station every ten miles, and feed five miles each way. Sections can be added, so that the trains can be run any desired distance. I shall make it perform what I have promised to do. There remains no other obstacle than working out the details so as to make it practicable."

In the New York *Electrical World* we read the following jottings on the same subject. "For the present," said Mr. Edison, "I do not think that electricity will be generally adopted for heavy freight trains or for passenger trains over long distances, but for street cars, elevated railroads and other short lines it will be found invaluable. Already we have applications for the use of our patents from Coney Island, Long Branch, Fairmount Park, Saratoga, and from the elevated railroads in New York. In the case of the latter it will effect not only a saving of 33 per cent. in the matter of coals, but it will also do away with one man on each engine, and further save the annoyance now experienced in the matter of the shower of sparks and the smell of sulphur which is so objectionable." When asked if he thought steam as a motive power would be eventually superseded by electricity, Mr. Edison said he had no doubt such would be the case, but not for some years to come. Steam, he said, is now and will be essential to the generation of electricity, but he believed that means sooner or later will be found to obtain electricity from the earth without the use of any machinery whatever.

Expert Quackery.—From a leading article in the *Electrical World* we extract the following:—"Incalculable damage has been done the science within the past few years by expert quackery. The great number of bogus electrical schemes which have been launched on the market, and buoyed up by expert 'gas' bought and paid for, have bled capitalists and made them shy of further financial dealings with electricity. It is owing to the exploits of the quack expert that a really good thing is now received with so much suspicion, and often lingers in development for want of encouragement. Public confidence in experts has been destroyed, and thus do the honest suffer for the misdeeds of the unprincipled. This condition of affairs should not be tolerated by the public. Better discrimination will eradicate this abuse. The lack of judgment on the part of those who employ experts has fostered quackery. We trust a simple ventilation will purify the odour of the expert business, without a course of active disinfection. Meanwhile, those who are called upon to express opinions should be conscientious with themselves and candid with their customers. The best and most lasting reputation is always *founded* on consistency and honesty."

Another Death from Electric Lighting.—In an American contemporary we read that a German employed by the Kansas City (Mo.) Electric Light Company was instantly killed about 9 o'clock p.m., June 20th. He was employed as lineman, and had been at work for several hours repairing some broken wires upon a high pole, and at last completed his job. As he started to descend he put out his right arm to steady himself and took hold of the main wire from the works of the company, not knowing that the current had been turned on. His hand touched a portion of the wire which was not insulated and the unfortunate man received the shock from an electromotive force equal to 2,000 volts, killing him instantly. The officers of the company state that the accident was caused by the non-delivery of a message sent to the works which ordered the superintendent not to turn on the current until specially notified.

Map of the World's Submarine Cables and Principal Telegraph Lines.—The Department of Public Works of the Diminion of Canada has published a map of the world, giving the principal cables and land lines now in operation, and the cables projected and abandoned. To it are added tabulated statements of the approximate distances and historical dates of some of the existing and projected principal main submarine cable routes. The map is of a large size and clearly lithographed, and cannot fail to be most useful to all interested in submarine cables and telegraph lines.

The Engineering and Metal Trades Exhibition.—Among the exhibitors at the Agricultural Hall, Islington, are several large manufacturers of belting. Messrs. John Tullis & Son, St. Ann's Leather Works, Glasgow, show a

high-class assortment, including the patent connected and single link chain leather belt, which is very suitable for heavy work and particularly recommended for the driving of dynamo machines, and for it it is claimed that it can accomplish 30 per cent. more work than any other belt with little or no trouble to the user. The joints are interlocked, and every foot is of the same weight, and on account of its steadiness in running it is specially adapted for electric lighting uses. This belt is now running at the Fisheries Exhibition. Mr. W. Willson Cobbett, London, exhibits samples of the Scandinavian patent cotton machine belting. Mr. Cobbett, the patentee, maintains that it is better to have cheap bands such as this "made in one continuous piece, pliable, uniform in section to a nicety, running always straight and without vibration, lifting less from centrifugal force when running at high speed on account of its light weight, from the same reason running with less sag or deflection at the lower pulley when used as a vertical belt, than to use leather at its best." The cost of its production is low, it is consequently very much cheaper than leather belting, and is calculated to run efficiently for seven or eight years. Messrs. John White and Sons, Bingley, an old-established firm, which continues to tan with oak bark, show some fine specimens of excellent finish and superior quality, and well adapted for electric lighting and power-generating purposes. A variety of chromate-tanned leather is to be seen at the stand of the Eglinton Chemical Company, of Glasgow, which is said to be superior to either india-rubber or canvas and equal to the best oak-tanned leather belting. At present there are but few purely electrical exhibits. The Electrical Portable Battery and Gas Igniting Company shows small portable igniting batteries and apparatus, which we described some time since. The batteries work well, and are specially recommended for safety. Messrs. Duncan Bros., London, exhibit Tate's patent electric valve-closing apparatus—already fully described and illustrated by us—an invention for the purpose of stopping steam-engines from any part of the works, in case of a break-down of machinery or other accident, or from any part of a steamship in the event of an impending collision. The Gower-Bell Telephone is one of the exhibits of Messrs. John Davis and Son, Derby. In the centre of the hall the Leeds Forge Company has formed a section of a boiler into a boudoir, which is pleasantly lighted from a storage battery in another part of the boiler with miniature electric lights.

An Electric Railway for Brighton.—The Brighton Town Council last week sanctioned the erection, temporarily, of a short electric railway on the beach.

Science Lectures.—It has been arranged with the Gilchrist trustees that a course of science lectures shall be delivered, under the auspices of the Galashiels Mechanics' Institute, during the session 1883-4. Mr. Lant Carpenter has been appointed one of the lecturers, and will discourse on experimental electricity.

Inventors and the Telephone.—In a leading article published in our contemporary the *Electrical World* of New York, the writer concludes that there can be no doubt that the telephone is susceptible of improvement, and that by *employing so powerful an agent as electricity, the telephone ought to reproduce sounds even more loudly and distinctly than they are uttered into it, as the telephone of the future probably will; so that it will not be necessary to hold the receiver to the ear and strain one's attention in order to make out what the speaker at the transmitter is saying.* If any one will produce a better telephone than the Bell, says our contemporary, and can force it, by its merits, upon the existing companies, he will no doubt reap his share of the rich harvest that the telephone is producing; but, under the decisions of the courts, he who merely produces a telephone varying in detail from the Bell telephone, and employing the same fundamental principle, can expect naught but trials and disappointments.

The Royal Society of Edinburgh.—At the meeting of the Royal Society of Edinburgh on Monday week a communication "On Superposed Magnetism in Iron and Nickel," by Professor C. G. Knott, D.Sc., was followed by the exhibition of a photograph of the arm of a boy struck by lightning. It was taken within three hours after the event, and showed leaf-like markings under the skin. The ordinary opinion on this subject was that the markings had a curious resemblance to the foliage of a young carrot, or something of that sort. It was thought that this must have been the impression of a yew tree near the scene of the stroke. Professor Knott considered the matter worthy the attention of every Fellow, and that they should know exactly what the effect of the action of lightning was by which those marks were produced. They were under the upper skin, but whether due to the discharge of electricity in such a way as to produce effects similar to this, as a blow which developed a slight extravasation of blood over certain portions, was a question that should be left to anatomists and physiologists. The photograph was examined with much interest by those present at the meeting.

Overhead Wires.—Some serious accidents have already called attention to a public danger which is daily increasing in London and other populous places, in the rapid multiplication of overhead telephone and telegraph wires. With imminent peril to life and limb, says the *British Medical Journal*, these wires are being stretched over streets in all directions, and it seems to be nobody's business to stop or even to control the nuisance. The Postmaster-General has stated in his place in the House of Commons that it is not his duty to interfere with the doings of private individuals and of public companies in the use of telephone and telegraph apparatus, so long as the privileges of the Government postal monopoly are not infringed. It is not difficult to make out a strong case against the increase of wires overhanging public thoroughfares. Such wires are very ugly, and they are really dangerous. At any time they may fall and maim and kill. Some day an extensive fire or a violent storm may cast down a sheaf of these wires upon the heads of a crowd and abruptly terminate the nuisance at the cost of a great calamity.

The Speculation in Electric Light Shares.—Electric light shares, which last year rose to fabulous prices, says a London contemporary, are well known to have fallen again to a ruinous extent for those who bought during the mania. So long as the public were inclined to buy, the contest between those in the market who had money and those who had stock was a very unequal one. The command of money was limitless, the supply of securities was strictly limited, and prices rose. After a time the rise ceased, and then came a collapse. Every now and then since the collapse there have been passing signs of another "rig," although nobody can expect to see such a rise as took place when the whole thing was new and nothing about the electric light was calculable in advance. Hammond shares, for instance, which rose to 20 or thereabout when the mania was in action, had lately dropped to par, which is 2½ per share; but dealers and outside operators who had been successful in selling the shares continually all the way down, to use their own expression, have not known when to stop, and are now caught by a rise, and are without the shares they had contracted to deliver. The price has advanced to 4, mainly or solely because the current settlement disclosed a scarcity of shares. In a word, the possessors of money have the non-possessors of shares again to some extent at their mercy. All electric companies expect to do better business when the autumn comes on and the pending Provisional Orders for local bodies are passed; but that is the immediate cause of the rise.

Theoretical and Practical Consideration of the Phenomena of Electro-Magnetic Induction.—By Gourant de Trommelin.—The author sets out with the following theorem: If a finite conductor is in motion in a uniformly magnetic-field the quantity of electricity which is thereby set in motion and developed by the induction to which the body is subject during its movement is equal to the surface, S, which encloses the projection of the conductor upon a plane vertical to the lines of force of the magnetic field, multiplied by the ratio of the magnetic-field, H, to the total resistance of the circuit, R.—*Wiedemann's Beiblätter.*

NEW COMPANY REGISTERED.

Lyons Electrical Power Storage Company (Limited).—Capital £400,000, in £1 shares. Objects: To acquire inventions, patents, and privileges in France and its Colonies, and more particularly in the Région Lyonnaise, relating to electricity and electric motive force. Signatories (with one share each): F. Lemercier, H. T. de Mangras, M.D., C. Savary, F. A. Dumond, all of Paris; F. Grant, 3, Copthall Buildings; C. R. A. Derby, 3, Crownfield Place, Leytonstone Road; J. Slater, 58, Haverstock Hill. Directors' remuneration: £2,000 per annum. Registered 7th ult., by Foster Hight & Co., 3, Copthall Buildings.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

North Woolwich Telegraph Works (Limited).—The first return of this company, made up to the 21st of March, was filed on 6th ult. The nominal capital is £100,000, in £10 shares. 312 shares have been taken up and £10 per share called thereon. The total calls paid amount to £1,800, leaving £1,320 unpaid. Registered office, 2, Tokenhouse Buildings, King's Arms Yard, E.C.

North Atlantic Cable Company (Limited).—The first return of this company, made up to the 13th of April, was filed on the same day. The nominal capital is £600,000, in £10 shares, but the only shares then taken up were the seven subscribed for by the signatories to the memorandum and articles of association. Registered office, 109, Fenchurch Street, E.C.

Domestic Electric Lighting Company (Limited).—The return of this company, made up to the 18th of May, was filed on the 31st of May. The nominal capital is £50,000, divided into 49,000 A and 1,000 B shares, of £1 each. 7 A and 100 B shares have been taken up, but no amount has as yet been called upon them. Registered office, 34, Walbrook.

Charakite Company (Limited).—An agreement, dated December 1st, 1882, was filed on the 6th ult., whereby this company will purchase from Richard Edward Goolden, of 2, Princes Street, Hanover Square, the benefit of an invention for an improved manufacture of insulated compounds, applicable also to other purposes, for which provisional protection, patent numbered 3,176, dated July 5th, 1882, has been granted. The purchase consideration is £5,500, payable £1,500 in cash and £4,000 in fully paid £5 shares in the company.

CITY NOTES, REPORTS, MEETINGS, &c.

The Eastern Telegraph Company (Limited).

THE twenty-second half-yearly ordinary general meeting was held at the Cannon Street Hotel, on Thursday, Mr. John Pender, M.P., the chairman of the company, presiding.

The Secretary (Mr. G. Draper) read the notice convening the meeting, and also the minutes of the previous meeting, which were approved of, and the report, which we published in our last issue, was taken as read.

The Chairman said the revenue for the six months ended March 31st last amounted to £328,405 against £321,810, being an increase of £6,595. They had exceptionally large receipts for telegrams from Egypt not only in the half-year under review, but in the previous six months. In order to earn that increased amount it was necessary to keep their system open for communication with Egypt at any cost. He might mention that they expended last year on that exceptional account over £62,000, employing in the service no less than six ships. Some of these expenses were charged against the September half-year; but some which were incurred before September appeared in the present accounts. Everything had now been changed and the result of the year's working must, the directors thought, be considered by the shareholders as satisfactory. (Applause.) The East and South African Company, in which the Eastern Company held almost all the shares, paid them the same dividend as last year, namely eight per cent. They had previously been paid ten per cent., and the reason of the fall had been the cessation of hostilities; but he should be very sorry if the cause which enabled them to earn ten per cent. should recur, because there was nothing so disastrous to a country as war. Although they might reap the immediate benefit of one or two per cent. in the case of war, he thought good trade and a prosperous country were likely to lead to a much more permanent profit, and he should be better pleased that their percentage should increase from commercial prosperity than from any hostilities that might again break out. The ordinary expenses of the company for the half-year had been £87,827, as against £75,140 in the previous half-year, being an increase of £12,687. That increase was accounted for by the working expenses at stations, which had increased by £8,863, and by the expenses incurred in opening six new stations, which they had done since March, 1882, namely at Athens, Corsica, Trieste, Corfu, Port Said, and Tripoli. They had also charged instruments, furniture, &c., against the revenue which might fairly have been charged to capital expenditure, therefore the £12,687 increase was not a permanent increase. The shareholders, he was sure, would approve of the course the directors had taken, as it was not desirable to increase the capital account if they could help it. The general expenses in London showed an increase of £1,000, which was attributable to stationery, printing, &c. They had published a book, which cost a trifle, a copy of which he was anxious should be placed in the hands of every shareholder. It would give them an idea of the vast extent of sea and land which that system of telegraphy occupied. He did not believe that any man, he did not care however intelligent or however high the position he occupied in political or commercial life, had the slightest idea of the extent of the ramifications of the telegraph system. The book was instructive and would give the shareholders even greater confidence than they had at present in the working of the telegraph system. As to law charges, there had been several exceptional items which had caused the increase. The increase in the expense of foreign agencies arose from the additional stations which they had opened. They had been obliged to open an agency at Vienna. There was a considerable increase in the depreciation of shares, and an increase of £1,900 in the maintenance of ships' reserve fund, owing to additional ships. In salaries there was altogether an increase in one way of £1,300, and a decrease, on the other hand, of £284. There was another expense in regard to the protection of submarine cables, a conference as to which was held at Paris. Another special item of expenditure this year was the bonus, amounting to about £1,200, to telegraph clerks, on account of the additional work they had during the Egyptian war, which the shareholders unanimously agreed to at their last meeting. He was happy to say that notwithstanding all these additional expenses they had carried to the reserve fund this year £85,000 as against £75,000 at the same period last year (applause). Wherever the directors could see their way consistently with the interests of the company they would be prepared to increase the dividend. The last dividend they paid was at the rate of 5½ per cent. They were now prepared to add by way of a bonus an additional half per cent., which would make for the year 6 per cent., at the same time carrying forward that large addition of £10,000 to the reserve fund. He thought, all things considered, the directors had shown that the past year had been one that had been largely beneficial to the company. He told them at their last meeting what had occurred during the Egyptian war—the great sacrifices the company had made in the interest, he might almost say, of the world; at all events very largely in the interest of the Government and of those conducting the war in Egypt. He repeated, that he believed that that war would not have been so short lived as it was had it not been for the extraordinary facilities which the commander-in-chief had through the telegraph, being enabled to keep up his communications with the admiral and with the other branches of the expedition in such a manner as to allow him to deal with the thing as a compact whole. He believed that the telegraph did signal service at that time, and he was glad to see that it had been appreciated to a certain extent. At all events, they had not lost by it, and the arrangements they had been enabled to make with the Government justified that expenditure. It had given them a very important position not only with the present Government but with other Governments. At that very moment another nation, a friendly nation, was engaged in war in the far East, and what did it do? They knew the benefits that company conferred on the British Government by the telegraph, and he believed at the present moment there was a convention being signed by the French which enabled that company to carry their system from Saigon to Tonquin. That was an additional feeder to them, because everything done in that direction brought so much traffic over the Eastern system. Since he had last the pleasure of addressing them they had laid another new line or triplicate line in the Red Sea from Suez to Aden. Cape Colony considered, as it was paying a handsome subsidy, it was entitled to a good service, and by their laying a third cable in the Red Sea they had been enabled to give such a service as was impossible to be beaten by any other system. That line had caused them considerable expense, but looking to the development generally of the East, which as far as China was concerned was but beginning, he looked on any expenditure in that direction as being likely in the future, and in the very early future, to produce very good fruits indeed. One thing he was pleased to say to-day, and it was the first time since 1879 that he had been able to say it, was that they had not a ship employed. All their cables were in good working order. If they could only avoid repairs they could make a very handsome addition to the dividends. He would now mention an incident in favour of duplication or triplication. They made an arrangement with the present Suez Canal Company for the construction of a land line from Port Said to Suez. They had that line opened, he thought, on the 28th June. It was only open about 24 hours, he believed, when their land line through Egypt, upon which they were previously entirely dependent was run into by a railway train, and the telegraph traffic on the line suspended for some days. Fortunately having secured the line along the canal no interruption was occasioned to their traffic. That was a very important incident, as showing the value of a duplicate system. The loss to them would have been a serious loss indeed if the whole of their traffic with the far east had been interrupted.

The question of a Suez Canal and the success of it had, as they were aware, been a question very much before the public, and he thought the Eastern Telegraph Company might claim to have been a very important factor in the great success which had attended the Suez Canal. In olden times ships very often carried their own letters; at all events, letters were carried by steam. Ships then had to wait sometimes a month, sometimes six weeks, and sometimes longer for their cargoes. Now, however, when a ship sailed telegraph messages were immediately sent to its destination, and arrangements made for the cargo. The ship arrived and was loaded and back she came again with her cargo. The dispatch thus effected was all due to submarine telegraphy. The submarine telegraph was at the beginning and also at the end of almost every operation that took place in the East, and was one of the most important factors in commercial life at the present moment. Coming again to the financial question, he thought it would be in the recollection of many of the gentlemen present that he mentioned that the directors were going to issue debenture stock, the object being to pay off the existing debentures, and replace them with debenture stock. Their experience, year after year, had satisfied them that submarine telegraphy was about as good a property as railway property. When a break occurred they knew where to find it, and could pick up the cable and repair it. Every year satisfied them that it was not an uncertain property. As to how long a cable might live, that was a question he was not prepared to answer. They had now had experience in cables of something like seventeen years, and he could say if they picked up any of their cables the core would be found to be as good as the day on which the cable was laid down. He had no hesitation in recommending their debentures as a sound and good investment. He did not see anything before the public at the present time which was as good or as safe an investment as their debenture stock. Already they had got an application for a very considerable amount of it. It would pay about 4¼ per cent., and they with the money would pay off their present debentures and also pay for their new cable. He looked for a considerable saving from the reconstruction of their debenture stock. He concluded by moving that the report and accounts of the directors be adopted, that a dividend of 6 per cent. be paid on the preference shares to the 30th June, and that in accordance with the directors' recommendation a dividend be declared of 2s. 6d. per share, with a bonus of 1s. per share, on the ordinary shares, making with previous payments by way of dividends a total payment of 6 per cent. on these shares for the year ending 31st March.

The Marquis of Tweeddale seconded.

In reply to Mr. Fisher,

The Chairman said he had already stated the opinion of the directors in regard to the company's property. When he told them they earned £400,000 a year net revenue and that the debenture stock took £20,000 of it, they could see it was a good investment. As to its permanency they had shown that it was as sound as any railway property could be, because they could repair it and did repair it, and thus kept it in a thorough state of efficiency. Let them also look to the reserve fund. It amounted to nearly £570,000. They might rest satisfied the security was a good one, notwithstanding that it lay at the bottom of the sea.

The motion was unanimously adopted.

A vote of thanks to the chairman closed the meeting.

The West Coast of America Telegraph Company (Limited).—The directors in their report for the year ending the 31st December last, state that the accounts show the gross revenue for the year to be £38,908 2s. 10d., against £32,356 15s. 11d. for the previous year, leaving a net balance of profit, after paying debenture interest, of £7,667 11s. 1d., a result, which, though not altogether satisfactory, is yet far from unpromising, regard being still had to the continuance of active hostilities on the West Coast, and to the utter paralysation of trade at Lima and elsewhere in Peru. Since the 31st December a considerable improvement has taken place in the position and prospects of the company. The mortgage upon the company's steamer and all the other liabilities and arrears of the company, set down at £20,465 8s. 5d. in the company's balance-sheet for the year 1881, have been discharged and extinguished, and the shareholders may now be congratulated on the company being at length a dividend-earning concern. Without counting upon any increase of business which may be reasonably looked for from the conclusion of peace, and the improved condition of affairs on the West Coast, the gross average earnings for the past six months point to an aggregate income for the current year of more than £50,000—a sum sufficient not only to meet all the current engagements of the company, but to form an adequate reserve, and also to pay a dividend on the ordinary shares. Instead of this income decreasing there seems to be every prospect of its increasing; whilst the company's expenditure will, it is hoped, show at the end of the year a diminution rather than an increase. The claim of this company upon the Chilian Government is still unsettled, but the board have unabated confidence in ultimately obtaining from the Government a reasonable and honourable settlement.

The United Telephone Company (Limited).—The directors of this company decided at their meeting on Friday of last week, subject to audit, and after making ample provision for depreciation, &c., to recommend a dividend of six per cent. per annum for the half-year ending April 30th last. They have also resolved to recommend to the shareholders at the annual meeting to be held on the 24th inst., the issue to the shareholders *pro rata* to their respective holdings of the remaining 20,000 £5 shares at £2 per share premium, payable by instalments as under: £1 10s. on allotment, £1 10s. on October 1st, 1883, and the remainder by calls to be made (subject to one month's notice) from time to time as required to meet the extension of the company's business. The transfer books of the company will be closed from the 11th to the 24th inst., both days inclusive.

The Great Northern Telegraph Company.—A telegraph station having been opened at Canton, telegrams for that place are now accepted for transmission by this company's lines at 8s. 7d. per word.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations, July 11.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	7	3½- 4	3⅝ m. 3⅞ a
		Do. Do.	10	6½- 7	
30,000	5	Australasian Electric Light, Power & Storage Co.	3	⅛- ¼	
24,900	10	British Insulite Co., Limited, "A" Shares	3	1½- 2	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	⅜- ½	
25,000	5	Great Western Electric Light & Power Co.	2½	⅜- ½	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	3⅛- 3½	3⅛ m. 3¼ a.
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	..	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½- ⅝	
..	..	Metropolitan Brush Electric Light & Power Co.	3	..	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	..	
..	..	South African Brush Electric Light & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Limited	2½	2½- 2⅝	2⅝ m. 2¾ a
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	49½- 50½	49½ m.
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until }	100	81½- 82½	82½ m.
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref. }	100	18½- 19½	
130,000	10	Brazilian Submarine, Limited	10	11½- 12	
16,000	10	Cuba, Limited	10	10½- 11	
6,000	10	Do. 10 per cent. Preference	10	17½- 18½	
13,000	10	Direct Spanish, Limited	9	5½- 5¾	
6,000	10	Do. 10 per cent. Preference	10	15½- 16	
65,000	20	Direct United States Cable, Limited, 1877	20	13½- 12½	
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	99 -102	
380,000	10	Eastern, Limited	10	10¾- 11¼	11 m.
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	13⅜ m.
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do do. Aug. 1899	100	104 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11⅛- 11¼	11⅛ m. 11⅜ a
50,250		Do. New Shares, 1883	10	11⅛- 11¼	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	109 -112	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -106	
140,000	100	Do. do. registered, repayable 1900	100	102 -106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	{ Eastern and South African Limited 5 per cent. } { Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	101 -104	103.2 m.
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust Limited	10	9½- 10¼	
163,390	10	Globe Telegraph and Trust, Limited	10	7½- 7¾	7⅞ m.
163,209	10	Do. 6 per cent. Preference	10	12½- 13¼	
125,000	10	Great Northern	10	12½- 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -102	
300,000	100	Do. 5 per cent. Debentures	100	101 -104	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	30 - 31	
100,000	100	Do. 6 per cent Debentures, 1886	100	103 -108	
17,000	25	Indo-European, Limited	25	31½- 32½	
34,148	10	London Platino-Brazilian, Limited	10	3½- 4	
12,060	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	5¾- 6¼	
9,000	8	Reuter's, Limited	8	9½- 10	
280,000	Stk.	Submarine	100	247 -252	
58,225	1	Do. Scrip	1	2¼- 2½	
4,200	Cert.	Submarine Cables Trust	100	103 -108	
37,350	12	Telegraph Construction and Maintenance	12	33½- 34½	⅛ m.
150,000	100	Do. 6 per cent. Bonds, 1884	100	98 -101	
186,750	5	Do. 2nd Bonus Trust Cert.	2½	1½- 1¾	
30,000	10	West Coast of America, Limited	10	4½- 5	
150,000	100	Do. 8 per cent. Debentures	100	104 -108	
69,910	20	Western and Brazilian, Limited	15	6 - 6¼	
		Do. Preferred	7½	5 - 5¼	
		Do. Deferred	7½	1½- 1⅝	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	105 -109	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	98 -102	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	122 -124	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,331	10	West India and Panama, Limited	10	1 - 1⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	6½- 7	
4,669	10	Do. 6 do. 2nd do.	10	5 - 5¼	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. to 154,165	1	⅜- ½	
200,000	1	Oriental Telephone Co., Nos. 80,001 to 300,000	¼	⅜- ½	
100,000	5	United Telephone Co.	5	9½- 9¾	9¾ m.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended July 6th amounted to £2,885.

The Eastern Extension (Australasia, &c.) Telegraph Company, Limited. The receipts for the month of June amounted to £34,307, and to £31,122 in the corresponding period of last year, an increase of £3,185.

The Eastern Telegraph Company, Limited. The estimated receipts for the month of June were £40,179, and £46,450 in the corresponding period of last year, a decrease of £6,271.

The Great Northern Telegraph Company. The receipts for June amounted to £23,360. The aggregate from January 1st to June 30th amounted to £122,880 compared with £116,527 in 1882, and £114,966 in 1881.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ended June 29th were £1,508, and for the week ended July 6th, £1,870, each after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The London and Globe Telephone Company.—This company has now a very considerable number of subscribers' offices joined up with its central exchange, and we understand about six hundred firms have signed orders for connection therewith as soon as practicable. The instruments to be used speak remarkably well, as will be readily understood when we say that they consist of very superior Hunnings' transmitters and what are known as *English Mechanic* receivers, *i.e.*, the receiver disclaimed by Bell on account of previous publication in the aforesaid periodical.

On Lacquering Holtz's Influence Machines.—E. Borchardt.—The discs are suspended by means of the hole in the centre to a wooden rod fixed to a table, and at the distance of 15 to 20 centimetres from a heated stove. They are then held obliquely and coated once, thinly and evenly, with a lacquer, consisting of 60 parts by weight of absolute alcohol, 40 parts of shellac, and six parts of Venice turpentine. The discs are warmed for a time and then allowed to dry for 10 to 15 hours. If the coating cracks it is scraped off, preferably after steeping the disc in water for a couple of days. In order to cleanse the movable disc, it is placed in a flat position, breathed upon, and rubbed with soft linen or blotting-paper.—*Wiedemann's Beiblätter.*

NEW PATENTS—1883.

3275. "Electrical railways and tramways." W. A. TRAILL. Dated July 2.

3277. "Electrical railways and tramways." W. A. TRAILL. Dated July 2.

3278. "Electrical conductor for telegraphic, telephonic, or similar purpose." H. H. LAKE. (Communicated by T. H. Dunham.) Dated July 3.

3302. "Telephonic apparatus." W. R. LAKE. (Communicated by H. Clay.) Dated July 3. (*Complete.*)

3308. "Automatic switch for electric lighting." C. F. POLLAK. Dated July 4.

3333. "Electric arc lamps." A. L. LINEFF. Dated July 5.

3340. "Improvements in and relating to electrical accumulators or secondary batteries, which improvements are partly applicable to other batteries." W. R. LAKE. (Communicated by C. Dion.) Dated July 5.

3376. "Conductors for electrical railways." H. E. M. D. C. UPTON. Dated July 7.

3380. "Telegraphic and telephonic apparatus." D. SINCLAIR. Dated July 7.

3392. "Electric arc lamps." F. M. NEWTON. Dated July 9.

3413. "Manufacture of material for electric insulation." W. V. WILSON. Dated July 11.

3423. "Apparatus for applying electricity for curative and other purposes." J. N. ARONSON. Dated July 11.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

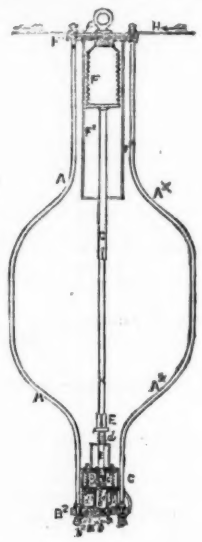
4824. "Incandescent lamps for electric lighting." E. MULLER. Dated October 11. 2d. This invention claims to be an improvement on the present incandescent lamps in the following particulars, viz., first, the interior glass tubes and carbon filaments used in the present lamps are dispensed with; second, a bar of carbonised wood is substituted for the filaments, and this is connected (by copper and platinum connections) with the wires conveying the electric current through sealed orifices on each side of the bulb of the lamp in lieu of being connected through the special tube at the base of the lamp as in existing lamps; third, the carbon bar is fixed in a simpler method, viz., (*a*) by inserting the connecting wires in a hole bored in each end, which wires pass out at the sides of the bulb, and join the conducting wires on each side thereof, or (*b*) the connecting copper wire is wound round each end of the bar in the shape of a spiral spring, and also round each end of the connecting platinum wires which then pass out each side of the bulb as before. (*Provisional only.*)

5300. "Electro-plating with nickel and cobalt." A. J. BOULT. (A communication from abroad by J. Vandermersch, of Belgium.) Dated November 6. 4d. Heretofore in plating articles made of, say, iron or copper with nickel, a very thin film only of the latter metal could be deposited on the article to be plated; this thin layer soon wears off especially when, as readily occurs with iron, oxidation of the subjacent metal takes place. Now the chief object of this invention is to obviate these difficulties and to enable thick layers of nickel to be deposited by means of electricity. In carrying this invention into practice the inventor adds to the bath of any suitable nature with a base of sulphate of nickel one or several acids which are capable of rectifying the impurities of the deposit and to provide at the negative pole a white and pure metal of excellent quality which also adheres strongly. Such acids are benzoic, salicylic, boric gallic and pyrogallic acids and others having similar properties. The bath with such addition, though it considerably improves the deposit yet produces only a thin layer, just as the usual sulphate of ammonia bath. To the bath prepared as aforesaid, the inventor adds pure or ordinary sulphuric acid in the proportion of about ten drops to the litre, and he is thus enabled to obtain a deposit of nickel of any desired thickness.

5400. "Carbons for use in electric lamps, &c." J. E. T. WOODS. Dated November 13. 2d. Consists of inserting during the progress of manufacture, wires of aluminium, magnesium, or other suitable metals having high conductivity and colourless flames in the centre of the carbon rods. These wires cause the lines of least resistance to the electric current always to be at the centre of the carbon points from which the arc will continually proceed. (*Provisional only.*)

5492. "Electric light switches." C. MAYNARD. Dated November 18. 6d. In the improved switch the inventor uses a double arm of metal, turning as if pivoted at its centre, and making simultaneous contact at two side plates.

5495. "Electric arc lamps." W. B. F. ELPHINSTONE, C. W. VINCENT, and J. COTTRELL. Dated November 18. 6d. The chief object of this invention is to simplify the construction of arc lamps, whether pendant or standard lamps, and enable them to be regulated with the greatest delicacy, whereby a steady light, unaffected by the feed of the carbon or carbons, will be insured. To this end the inventors adapt to the lamp an arrangement of pneumatic apparatus which, aided by the action of a solenoid, will control the movement of the carbons as desired. The figure shows in front elevation (partly in section) a pendant arc lamp constructed according to the invention. A A* is the metal suspension frame, carrying at its lower end a solenoid, B; B^1 is the hollow bobbin of the solenoid, which is closed at bottom by a thick plate of metal, B^2, to which the rods of the suspension frame are secured by clamping screws. The plate, B^2, is pierced with a fine hole, *b*, for a purpose to be presently explained. In the centre of this plate a seat, b^1, is formed for a small conical valve, and leading horizontally from this seat to one of the rods forming the suspension frame is a passage, b^2. This rod is hollow



throughout its length, and it is insulated from the plate, B^2. Made fast to the bobbin of the solenoid is a cylindrical case, C, which forms a guide for the soft iron core, D_1 of the solenoid. To the upper end of this core is attached the lower carbon-holder, E, and a tendency is given to it to stand at its highest elevation by means of a light spring, *d*, surrounding the stem of the core, D. Attached to this stem of the core and fitting loosely in the box, C, is a disc, which forms the top of a short bellows, C^1, of the concertina type, the lower edge of which is made fast to the bobbin of the solenoid. Pendant from the core, D, is a loose rod, d^1, carrying at its lower end a conical valve, d^2 (formed of non-conducting material), which is held to its seat, b^1, by a light spring, d^3, surrounding the valve rod and bearing against the bottom of the core and the top of the valve; this will admit of the core moving vertically to a limited extent without affecting the valve which is attached thereto. The passage, b^2, is brought into communication through the hollow suspension rod, A, with a second bellows, F, pendant from the upper upper part of the frame, and carrying the upper carbon-holder, G. This bellows, F, is made fast to the under side of a plate, F^1, which is attached by clamping screws to the rods of the suspension frame, but is insulated therefrom. A passage, *f*, is drilled in this plate, F^1, to bring the bellows into communication with the hollow rod. Attached to the under side of the plate, F^1, by screws, is a cylindrical metallic, F^2, which encloses the bellows, F, and forms at its lower end a guide for the upper carbon-holder, G, to slide in freely. The electric current passes to the lamp by the wire, H, which is clamped to the plate, F^1, and from this plate it passes through the carbons to the solenoid. This solenoid is brought by an extension, B^*, of its wire into electrical connection with the lower end of the insulated hollow rod, A, of the pendant frame, the upper end of which is in connection with the return wire of the circuit. Supposing now the upper bellows, F, to be wholly or partially collapsed, and the lower bellows

to be expanded the carbons being in contact; on passing an electric current into the lamp the current will flow down through the carbons to the metal box or cylinder, C, which contains the bellows, C^1, of the lower carbon-holder, E, and is in metallic connection with the solenoid, B. The descending current passing from the lower carbon-holder to the box will enter the solenoid and cause the core, D, to be attracted, whereby the lower carbon will be drawn down to form the arc. After traversing the solenoid the current will pass up the insulated rod, A, of the suspension frame to the return wire, and so complete the circuit. As the arc lengthens by the consumption of the carbons the strength of the current will be proportionately weakened, and the attraction of the solenoid will consequently lessen. On this occurring the spring, *d*, will force up the lower carbon and restore the arc. This action will continue until the lower carbon has attained its maximum height. So soon, however, as the arc by the burning away of the carbons becomes unduly lengthened, and the solenoid consequently weakened the core, D, will lift the valve, d^2, from its seat and allow air from the box or cylinder, C, to pass along the air passage, b^2, up the hollow rod, A, in a regulated amount into the upper bellows, F. This admission of additional air to the bellows, F, will cause the expansion of the bellows and allow for the dropping of the upper carbon to restore the arc. Simultaneously with this descent of the upper carbon the current will be strengthened. The solenoid will then draw down the core, D, together with the lower carbon which it carries, and cause the valve to be seated. For supplying air to the solenoid box or chamber its bottom is pierced as at *b*, and this opening may, if thought desirable, be governed by a small screw plug.

5504. "Incandescent electric lamps." A. SWAN. Dated November 20. 6d. Relates to the manufacture of incandescent electric lamps, and has for its object to give a more complete adhesion between the glass or the like and the terminal wires which pass through the said glass or the like to the carbon filament, and prevent the formation of air bubbles along the track of the wires. According to the said invention, the inventor passes an electric current through the wires at the same time that the glass or the like is being pressed around them. This may be effected in any convenient or suitable way.

5518. "Distribution of electricity by underground conductors, &c." C. D. ABEL. (Communicated from abroad by L. A. Brasseur, of Brussels.) Dated November 20. 6d. The invention consists of pillar boxes, by preference made of cast iron, which are hermetically closed and contain one or more sections of conducting cables according to their length, the subscribers' wires being connected to the nearest section. The conduit, which may be of cast iron or other material, is by preference provided with a hinged cover, and is of a size corresponding to the number of conductors it has to contain. The communication with a subscriber is effected by means of a small special cable connected directly with the nearest pillar box; at the point where this cable leaves the conduit it is passed through a tube of iron or other material leading to the house to be connected. A perforated horizontal partition divides the conduit into an upper and lower compartment, of which the former serves to receive the cables, while the latter serves as a drain for leading off any water, which may be conveniently drained off from the bases of the pillar boxes. This arrangement, firstly, allows of the placing of the cables in position without dragging and consequent wear; secondly, it obviates the making of joints underground, and allows wires to be used of the entire and exact length required, without excess being necessary as at present; and, thirdly, it allows of the rapid uncovering of the section where a fault has occurred, which fault can then be remedied in a very short space of time and comparatively without cost. The pillar boxes, which may be of any convenient form, have in their upper parts insulated plates carrying rows of pinching screws arranged in pairs one above the other, each pair being connected together by a conducting wire and serving to receive the two ends of one of the wire conductors, the cables of which are led up on each side of the plate from the ends of the two conduits, which open into opposite sides of the pillar box. The conducting wires of subscribers situated along a particular section of the conduit are led separately through such conduit to the next pillar box in the direction towards the central station, and are there each connected to one of the pairs of pinching screws, while the several wires of the said subscribers passing from the pinching screws to the next section of the conduit are formed into a single cable. Each pillar box is by preference provided with a lightning conductor in order to prevent the conducting wires from being affected by atmospheric electricity.

5525. "Dynamo-electric machines." W. H. AKESTER. Dated December 17. 6d. Has for its object to improve the construction and action of dynamo-electric machines. In carrying out the invention according to one modification two bars of iron or steel are placed parallel to and on opposite sides of the main rotating shaft to which the driving power is applied. Pole-pieces are fixed to the inner sides of the bars at the ends of each, the north and south poles of one bar being placed opposite the south and north poles respectively of the other bar. The inner faces of the pole pieces are made concave, and they are by preference fixed to the bars so as to leave spaces between them and the bars except near the outer ends. These bars with their pole-pieces constitute the stationary magnets, and are excited by means of insulated wires wound round the middles of the bars, and then round the parts where there are spaces between the bars and the pole-pieces.

5566. "Exhausting the bulbs of incandescent electric lamps, &c." N. K. CHEBRILL. Dated November 22. 4d. Relates to improvements in the means employed to obtain the vacuum needed for incandescent electric lamps, or other purposes, and has for its object to produce a very high or perfect vacuum with rapidity and convenience. The inventor passes into, or forms in the bulb or article in which the vacuum is to be formed, a gas, which when caused to issue therefrom, will pass into, over, or through a substance, with which it will combine, so that it leaves behind it a vacuum in the bulb or other article, and being converted into a non-gaseous form before it reaches the pump (if such be used), the said pump acts as an auxiliary to the chemical means for producing the vacuum; thus ammoniacal gas is used as the gas with which to fill the bulb or other article and phosphoric anhydride as the substance which is placed in the passage between the said bulb or other article and the pump. On the pump being set to work the ammoniacal gas will be drawn from the bulb or other article, and in passing over the anhydride it will combine therewith, leaving behind it a vacuum in the bulb or other article.

5601. "Secondary batteries." A. TRIBE. Dated November 24. 4d. Relates to improvements in the construction of the positive plates or elements of secondary batteries. In carrying out the invention, the inventor proceeds according to one or other of the following methods:—A rectangular frame, the same by preference being grooved, may be employed, having three sides of prepared wood, slate, porcelain, or any non-conducting substance not easily acted upon by dilute sulphuric acid. The fourth side is completed by the employment of a suitable conductor, preferably of lead, the same being allowed to project beyond the liquid. Or the frame may be made entirely of any suitable conductor, but lead is preferred, or the frame may be made entirely of prepared wood, porcelain, or slate, a suitable conductor preferably of lead being placed within the groove, and passing round the frame, or simply down one or both sides either partially or wholly. Into or upon one or other of these or some other equivalent form of frame, is placed peroxide of lead or minium or peroxide of lead or minium in admixture with compounds of lead, such, for example, as the oxides of lead or the sulphate of lead or mixtures of the same. The peroxide of lead or minium, or the mixture of peroxide of lead with oxide of lead or sulphate of lead or with mixtures of the same is or may be brought to the desired consistency by the employment either of water or, by preference, of dilute sulphuric acid, and if necessary be allowed to remain in the retaining frame until the mass has consolidated. Or a core consisting of compressed peroxide of lead, minium or of mixtures of the same, either alone or in conjunction with monoxide of lead or with sulphate of lead may be fitted into the centre of the retaining frame, and to which is applied a mixture of a suitable consistency consisting of peroxide of lead or minium or peroxide of lead or minium in admixture with other compounds of lead such as sulphate of lead or the oxides of lead or mixtures of the same in conjunction either with water or with dilute sulphuric acid. The plate, plates, or element prepared by any one of the hereinbefore described methods, and of any convenient shape other than that mentioned is or may be ensheathed or encased in any suitable porous supporting wrapper, such as felt, flannel, calico, asbestos, cloth, &c., the plate thus encased is then reduced to the metallic condition electrolytically as is well understood.

6085. "Telephonic apparatus." W. R. LAKE. (A communication from abroad by M. F. Tyler, of America.) Dated December 20. 6d. Consists in constructing a chamber outside of and surrounding the exposed part of the diaphragm of a telephonic transmitter, the said chamber having an opening (preferably upon the side opposite the diaphragm), formed to receive the mouth and the adjacent parts of the face, as hereinafter described, so that the lips of the person making a communication are within the said chamber and the opening is substantially closed by the face, whereby the vibrations imparted to the atmosphere by the voice will be confined within the chamber and directed to the diaphragm independently of the surrounding atmosphere. Communications may then be made in a whisper, and consequently will not be heard except by the party listening at the receiver at the other end of the line.

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17. "Electric lighting and power distributing systems." SYDNEY PITT. (A communication from abroad by Eli T. Starr and W. J. Peyton, of America.) Dated January 1. 6d. Relates more particularly to a system of distributing electrical energy or power from a generator or generators by means of automatic or time switches, whereby an electric current or currents may be automatically directed to or cut off from apparatus to be acted upon or worked by the current or currents at predetermined times.

261. "Electro-telegraphic systems." P. M. JUSTICE. (Communicated from abroad by T. M. Foote, of New York, and H. C. Goodspeed, of Boston, America.) Dated January 16. 1s. 4d. This invention relates to a system of electro-telegraphy which is distinguished by the name of Foote's Telegraph System; to a form of perforated fillet, and to an ink writer or recorder adapted to this system. The first part of the invention consists of a receiving instrument, of construction hereinafter described, in which two pens are operated alternately, one by electrical impulse over the line, and the other by a local force, whereby impulses of a single polarity transmitted over the line are utilised, to make a record in dots and dashes on one line, while other dots and dashes constituting the other part of the complete record are made in the intervals between the impulses aforesaid. This part includes also an improved fillet adapted to be used in connection with the said receiving or recording instrument. The second part of the invention consists of an improved perforator for punching the aforesaid fillet.

535. "Electric motors and dynamo-electric machines." SYDNEY PITT. (Communicated from abroad by F. B. Crocker, C. G. Curtis, and S. S. Wheeler, all of America.) Dated January 31. 6d. Relates to all such electric motors, or other electro-dynamic machines as are actuated by (electric currents supplied to them from unlimited sources of) electrical energy, that is to say, from sources from which currents of greater or less strength may be derived, according to the amount of power which it is desired to have developed by the motor, and the object of the invention is to provide means whereby the power or speed developed by such motors may be increased or diminished in the most efficient and economical manner. The invention, broadly

stated, consists:—1st. In so constructing the field-magnets of the electric motor that their internal resistance may be varied at pleasure; 2nd. In so constructing the armature that its internal resistance may be varied, and; 3rd. In so combining the armature with the field-magnets that the total internal resistance of the machine, as a whole, may be varied.

1120. "Telephonic apparatus." W. R. LAKE. (Communicated from abroad by E. Holmes and E. T. Greenfield, of America.) Dated March 1. 6d. Relates to improvements in telephonic exchange systems and to apparatus therefor. The said invention partly consists in the combination in a telephonic exchange system of a number of subscribers' service lines with a multiple telephonic receiver at a central office, normally in circuit with the service lines, a single telephonic transmitter at the central office, normally out of circuit, and means whereby this telephonic transmitter may be put in circuit with any of the service lines.

1135. "Electrical accumulators." W. R. LAKE. (A communication from abroad by N. S. Keith, of America.) Dated March 2. 6d. This invention relates to that class of secondary batteries commonly known as the "Planté" battery, inasmuch as it depends upon oxidation and reduction of lead. The said invention has for its object to reduce the cost, facilitate the manufacture, and increase the electrical efficiency and capacity, and other desirable practical requirements of the said batteries. The said invention consists essentially in the combination of a positive electrode, the active part of which is finely divided metal deposited thereon by electro-deposition, and a negative electrode, the active part of which is a spongy metallic compound deposited thereon by electro-deposition, either one or both electrodes being contained in a porous envelope or receptacle. Fig. 1 is a vertical longitudinal section of a battery cell constructed according to this invention. Fig. 2 is a plan showing the arrangement of four cells in a group. A is the terminal of the wire which connects all the plates or electrodes of one kind, and B the terminal of the wire which connects all the plates or electrodes of the other kind, in the manner well known as for "quantity" or "multiple arc" in ordinary galvanic batteries. *d* indicates the conducting core or lead plate; *e* a porous

FIG. 1.

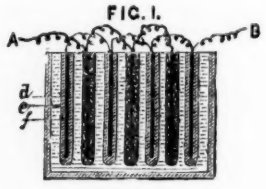
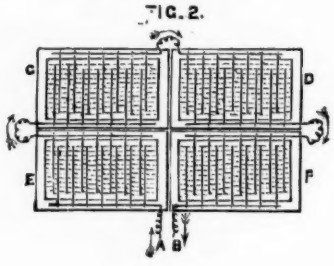


FIG. 2.



envelope (in this case having the form of a bag), and *f* the spongy material either metallic or oxidised. C, D, E, and F in fig. 2 represent four such cells, the plates in each of which are arranged for "quantity," while the cells are placed in series, after a well-known arrangement. A and B represent the terminals of the circuit, and the arrows the direction of the current when receiving the charge, which direction is reversed during the discharge. In carrying the said invention into practice the inventor takes a solution of some salt of lead, such as the acetate or the nitrate, which solution must be either neutral or preferably alkaline in its reaction, and uses that for a bath, in which he suspends two or more sheets or other forms of lead as electrodes connected in alternate order with the positive and negative poles of a source of electricity. The inventor encloses the electrodes in bags, or other containers, made of fibrous material, which will allow the passage of the electrolyte through their meshes, but will also retain the oxides in contact with the electrodes which they incase. This he does before placing the electrodes in the electrolyte and before connection is made with the source of electricity; and he retains the bags upon the electrodes for the purpose of keeping the deposits upon the different electrodes from mixing.

1192. "Underground conduits for electric wires." A. J. BOULT. (Communicated from abroad by W. Plankinton, of America.) Dated March 6. 4d. Relates to the laying of electric wires.

1313. "Dynamo-electric machines." H. H. LAKE. (Communicated from abroad by G. W. Fuller, of America.) Dated March 12. 8d. Relates to improvements in dynamo-electric machines, which improvements are designed to increase the steadiness of their operation and to add to their efficiency. The inventor increases the steadiness of operation by rotating the field-magnets; and adds to the efficiency of the machine, by making the armature core independent of the coils which surround it, and by keeping all parts of the core in unchanged polar relation to the field-magnets.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," ELECTRICAL REVIEW, at above address.

CORRESPONDENCE.

Electric Lighting.

I read the leading article in your issue of 30th ult., on the subject of the paper read by Mr. Gordon before the Society of Arts' meeting last month, with some degree of interest.

For some time past I have been using an Edison D machine for lighting my house, and a few months ago I fixed in connection with the same an Elwell-Parker and Planté storage battery, with the following result:—

The battery being partially charged, if I extinguish a number of the lights while the dynamo is running at its usual speed, the surplus current runs into the accumulator, thus relieving the remaining lamps of the extra strain to which they would otherwise be subjected.

In the event of the engine being stopped, the engineer switches off the connection between the dynamo and the accumulator, and the lights are then supplied from the accumulator only, the lights are then, however, slightly less brilliant; but a few more cells are switched on at the same time and thus the deficiency is instantly made up without any break-down in the light.

No experienced men are required to watch the light as suggested by Mr. Gordon, nor is any other regulator required; the stoker can manage the work with ease.

T. Tayler Smith.

Bush Hill Park, Enfield, *July 4th*, 1883.

On Dynamo Machines.

In your last number Professor Forbes points out what he alleges is an error in an equation of mine in your issue of June 9th.

I beg to point out that Professor Forbes has probably been misled to that conclusion by having overlooked a well-known law applying to derived circuits, namely, that a current divides itself between multiple arc circuits inversely as their resistance, and from this law naturally follows the rule that the "sum of (resistance of each derived circuit × square of its current)" is equal to (joint resistance of the derived circuits) × (total current)^2. It therefore follows that the formula which Professor Forbes gives as correct is equal to the formula given by myself.

The algebraical proof of this is as follows:—

Professor Forbes says the total energy expended in the circuit should be equal to—

(current of armature) $^2\times$ (resistance of armature);
+ (current in magnet coils) $^2\times$ (resistance of magnet coils);
+ (current in line) $^2\times$ (resistance of line).

This algebraically expressed is:—

$$\left(\frac{\sqrt{r_1}}{r_1+\frac{L\,R_1}{L+R_1}}\right)^2 r_1+\left(\frac{\sqrt{r_1}\quad L}{\left(r_1+\frac{L\,R_1}{L+R_1}\right)(L+R_1)}\right)^2 R_1+$$

$$\left(\frac{\sqrt{r_1}\quad R_1}{\left(r_1+\frac{L\,R_1}{L+R_1}\right)(L+R_1)}\right)^2 L$$

which equals—

$$\left(\frac{\sqrt{r_1}}{r_1+\frac{L\,R_1}{L+R_1}}\right)^2\left(r_1+\frac{L^2}{(L+R_1)^2}R_1+\frac{R^2}{(L+R_1)^2}L\right)$$

$$=\left(\frac{\sqrt{r_1}}{r_1+\frac{L\,R_1}{L+R_1}}\right)^2\left(r_1+\frac{L\,R_1\,(L+R_1)}{(L+R_1)^2}\right)$$

$$=\left(\frac{\sqrt{r_1}}{r_1+\frac{L\,R_1}{L+R_1}}\right)^2\left(r_1+\frac{L\,R_1}{L+R_1}\right)$$

this last value being the one given by me.

W. Moon.

July 7th, 1883.